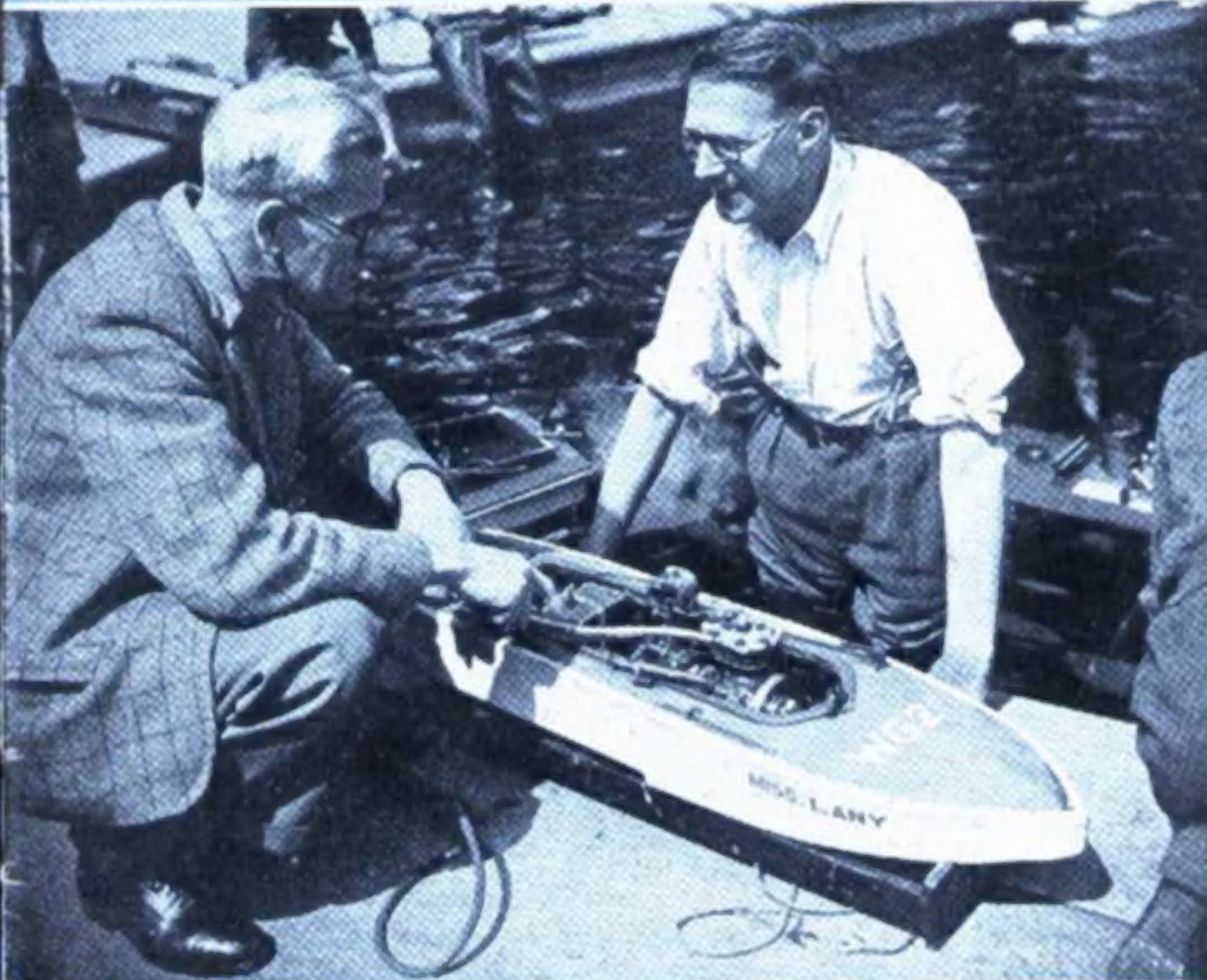
THE MODEL ENGINEER



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THE MODEL ENGINEER

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Our Cover Picture

Now that spring is here again, many of the "outdoor sports" associated with model engineering are emerging from their winter hibernation and showing renewed activity; the result of several months of work in the workshop are being put to the test in preparation for another competition season, and are the main topic of conversation at every model race track, aerodrome and boat pond. The interest and enthusiasm shown by the exponents of these models constitute one of the incidental, but by no means insignificant, pleasures of model engineering. Few pursuits can offer such a varied yet continuous interest, in and out of season, and in and out of doors. Our photograph represents a typical scene at any model power boat meeting, depicting Mr. Atkinson, of the Welling (Kent) club, discussing technical points about his motor launch *Miss L. Ang* with a friend; this boat, by the way, is fitted with an interesting twin-cylinder petrol engine of original design. The photograph was taken two years ago at the Festival Regatta at Victoria Park.

SMOKE RINGS

"Model Achievement"

WE HAVE been favoured with a copy of an illustrated brochure entitled "Model Achievement," issued by the Model Engineering Trade Association. It consists primarily of a collection of photographic illustrations depicting models of ten steam locomotives, four electric locomotives, 81 various coaches (including luggage and Post Office vehicles), 143 pieces of freight stock and some examples of land transport of the pre-railway era, all specially built by manufacturer-members of the Association, for display at the Van Riebeeck Tercentenary Exhibition held in Cape Town last year.

The brochure certainly provides a lasting and telling record of a remarkable achievement of which the Association may justifiably feel proud, especially in view of the fact that all these models had to be made and despatched to South Africa in little more than eight months. The illustrations give a good idea of the high degree of accuracy that was the most striking feature of all the models concerned, and, at the same time, they pay a very strong, if silent, tribute to the skill of British craftsmen.

Inside the back cover of the brochure is a list of the eleven manufacturers who took part in this remarkable achievement; they deserve warm congratulations. We feel, too, that the Association is to be highly commended for its enterprise in producing the brochure.

"Rotarian" Exhibition of Hobbies

NEWS HAS reached us of two exhibitions to be organised by local Rotary clubs; one is to be held in Abergavenny, Mon., from April 7th to 11th, at the Drill Hall in that town, and will be open to the public from 3 p.m. to 8 p.m. on each of the five days; the other will be at the County Theatre, Ashford, Kent, from April 22nd to 25th, also opening from 3 p.m. to 8 p.m. each day.

In each case, every kind of hobby, including model engineering, is to be represented, and "M.E." readers are invited to send in exhibits. For the Abergavenny exhibition, readers should get into touch with Mr. E. G. Jackson, "Hay Tor," Wyndham Road, Abergavenny, Mon.; arrangements for the Ashford exhibition are in the hands of Mr. Kenneth L. Hebden, "West Mede," 47, Albert Road, Ashford, Kent.

The Talyllyn Railway

WE HAVE received a further report from the Talyllyn Railway Preservation Society, whose good work continues slowly but satisfactorily.

Since the end of the summer season, the small permanent staff at Towyn has been engaged in work on the track and useful progress has been made. At several week-ends, parties of members have visited the line and put in some excellent work, as a result of which quite a number of lengthy stretches of track have been put in order. Further parties are already organised and it is anticipated that there will be a big influx of volunteers during Easter week-end. Most of these parties come from the North Western Area, which shows great enthusiasm for this work.

The society will be pleased to supply film-strips and a colour film for display at meetings and can generally find a lecturer also, to describe the workings of the railway and enquiries will be welcomed. For London and the Southern Area, please write to T. W. Robertson, 23, Portway, Ewell, Surrey; for the Midlands and the North, please write to O. H. Prosser, 38, Lynton Road, Sutton Coldfield, Warwickshire.

The Reading S.M.E.E. Exhibition

IN OUR issue for March 12th, the date of the forthcoming exhibition of the Reading Society of Model and Experimental Engineers was given as April 27th to 30th. This should have read May 27th to 30th; will all readers interested in attending or contributing to the exhibition please note this correction.

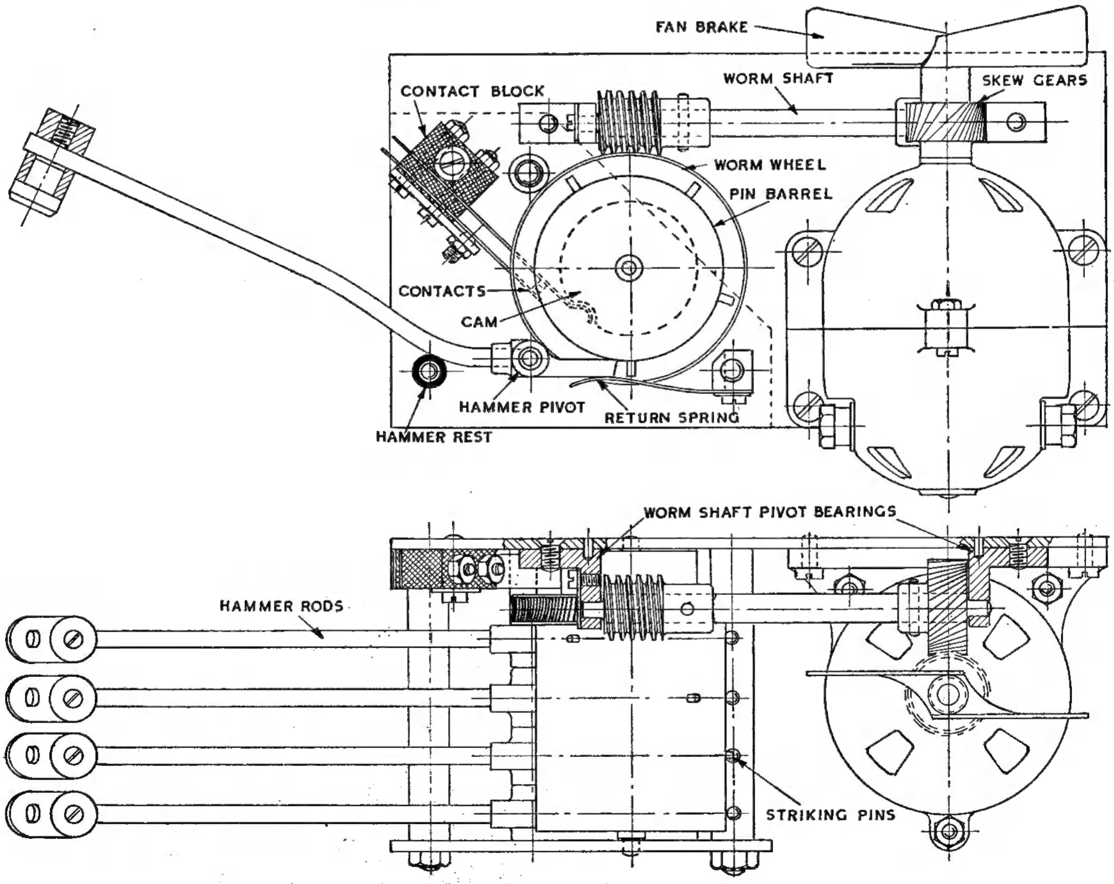
A set of door chimes

Constructional details of a useful domestic appliance

By " Artificer "

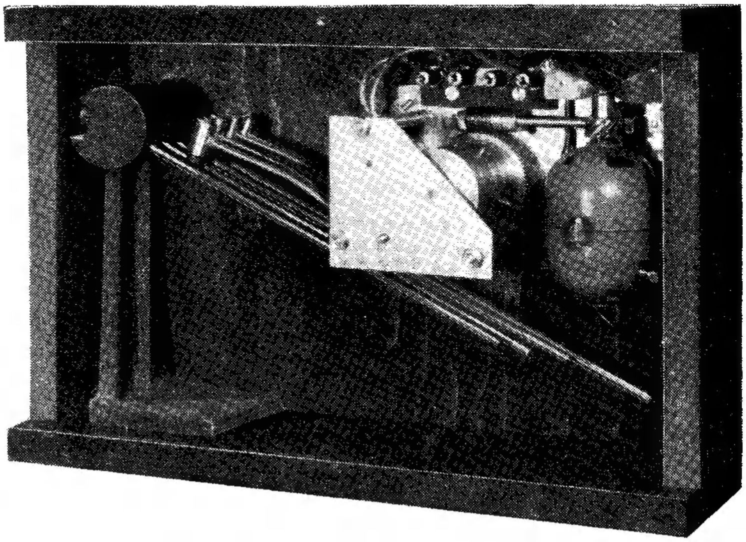
ALTHOUGH noise is generally regarded as one of the evils of civilisation, it is surprising to what an extent human beings will inflict upon themselves, and on other people, extraneous noises, which can hardly be regarded as strictly necessary and are by no means as euphonious as they might be. There is a steady increase in the number of " audible signals " and " warnings " of every kind which we have to put up with, and it matters little to us whether the tintinabulations of the modern electric bell are more difficult to live with than the jangle of the old-fashioned bell with its chains and bell cranks—the trouble is that we have to encounter it so much more often nowadays. Some attempts have been made to vary the tones of these signals, or to make them more melodious—a point that has never been entirely neglected by makers of striking and chiming clocks—and this is at least a step in the right direction. Chiming door-bells are now becoming increasingly popular, and various types are available, ranging from the simple two-note " ding-dong " to devices of fearful and wonderful complexity which play anything from jazz to grand opera.

Some time ago, I undertook, under duress from the domestic powers, to produce a chiming door-bell—I may add that a long-standing promise to do so was only brought to fruition by the threat to buy one, which would have been an insult to model engineering dignity, and also provide a further link in the chain of evidence that the workshop " never produces anything really useful." All model engineers, I venture to suggest, come up against this allegation at times, and have to do something to justify their existence—not to mention the expenditure of hard-won savings on tools



and equipment in the face of insatiable claims for improvement or renewal of domestic amenities.

At the time this job was undertaken, no exact details of chiming bell mechanisms were available, but it did not seem an unduly difficult problem to scheme something out on the basis of known principles. It was decided to go a little better than the simple "ding-dong" chime, as two notes, however melodious and well arranged, seemed to have very definite musical limitations; and although much the same argument could be applied to four notes, they do at least give scope for simple permutations.



The complete mechanism and tuned chiming rods, mounted in its case

Electrophobia !

I know that many model engineers who are quite happy with the most complicated mechanical problems have an aversion to "mucking about with electricity," and particularly to any job which involves the need for windings of any kind. The production of a few magnets or solenoids to operate bell hammers is not by any means a difficult job, even if it involves a little experimental work to obtain the most efficient results, but most of my friends in the fraternity would, I know, avoid it like the plague. In the design of this particular set of chimes, I decided to cut the electrical hanky-panky to the irreducible minimum, by using a mechanical method of operating the hammers, and employing electricity only to supply the motive power. Apart from the battery, wiring and bell-push, all that is required in the way of electrical gear is a small electric motor and a pair of contacts. It is not proposed to argue whether this method of operation is better or more efficient than using electro-magnets or solenoids; all that is claimed is that it works reliably, and is simple and straightforward in design and construction. The idea is not claimed to be original, either, as it involves principles to be found in musical boxes, chiming clocks and barrel organs, the origins of which are lost in antiquity.

Operating Mechanism

The basis of this is a simple pin-barrel, which is driven by suitable gearing at a slow speed and completes its sequence of operations in one revolution, lifting four hammer levers and allowing them to drop in the required sequence. It is, of course, quite clear that this could be adapted to operate any number of hammers in reason, in varied sequence, according to the arrangement of the pins, and its control gear could be modified so that the motion is arrested after only a part of the revolution is completed, so that it could be adapted for successive permutations, such as chiming the quarters, as an accessory to a clock.

In this particular arrangement, the hammers fall by gravity, but are given light assistance by leaf springs, the strength of which may be adjusted to vary the weight of the blow, and thus the volume of sound. If the hammers are required to work in a different position, it may be found necessary to use stronger springs. As at present arranged, the chimes are struck on tuned rods, which are small and compact, but bells, gongs, or tubes could be used if preferred. The rods, however, are simple to make and adjust, or can be obtained ready made and tuned from dealers in clock materials.

Motion Work

The driving mechanism comprises a small low-voltage electric motor, in conjunction with skew and worm gearing which provides a suitable ratio of production to the pin barrel. On the shaft of the latter, a disc cam is mounted, which operates a pair of contacts ; for the major part of its circumference, the cam surface is circular and concentric, and the wiper blade of the contact gear bears on it so as to keep the contacts closed, but at one point there is a dip in the cam contour which allows them to break. This is timed to occur at the "zero" or starting position, with all the hammers free and before starting the sequence of operations. The motor is wired in series with the battery, connecting line and bell push, so that when the circuit is completed by pressing the latter, the motor is energised and starts running, rotating the pin-barrel through its reduction gearing. This causes the cam to press the contacts together, and as these are wired in parallel to the connecting line, they short-circuit the bell push, so that the motor is kept running for one complete rotation of the barrel, when the cam allows the contacts to open and the motor is stopped. That is, assuming that the bell push has been operated for a brief period, in the normal way; if however, it is kept depressed, the sequence of operations will be repeated indefinitely, but always completing its last cycle before stopping.

This, I think, is about the simplest form of mechanism which could possibly be used to operate the chimes by electrical means, and should present no difficulty to the constructor whose electrical experience (or confidence ?) is limited. Any small electric motor can be used, as little power is required to drive the pin-barrel at its reduced speed. The particular motor shown is a Frog "Whirlwind" motor, obtainable from all model supply shops; this is quite a well-designed job, which unlike most of the motors in its class, not only looks like what it purports to be, but also has some *real* bearings, so that it runs silently and will stand continuous running for an indefinite period. It has a

low current consumption, and works at voltages from 3 to 8.

Some of the small motors available on the surplus market would be quite suitable for this purpose, their only disadvantage being that they are usually wound for voltages which are rather inconvenient for the means of supply normally available. In many cases, however, these motors will run on alternating current, and could thus be fed from a suitably wound transformer. The Frog motor, it may be mentioned, has a permanent magnet field, and thus would not run on a.c., unless rectified by a full-wave rectifier.

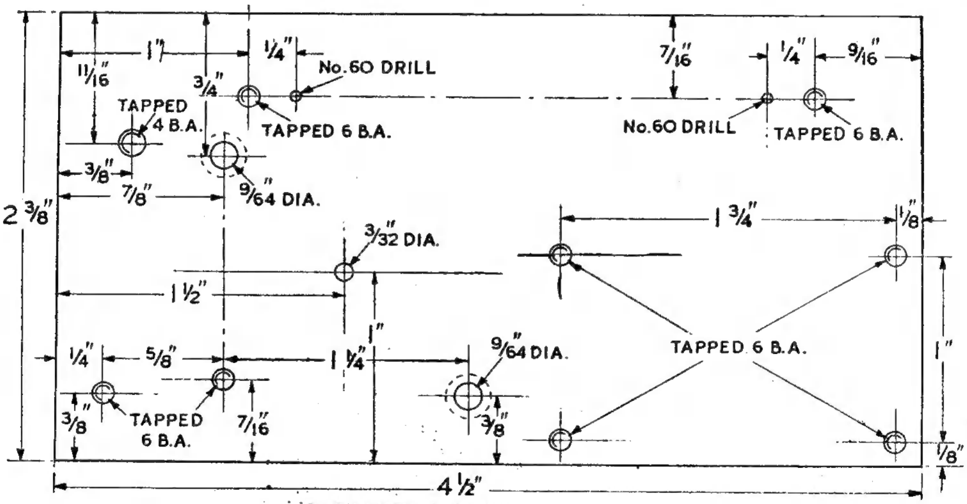
It will be observed that the motor shaft is fitted with a small fan brake, or "fly," as our horological friends would call it, the object of which is to prevent widely varying speed, as the load on the motor is not constant. A much better means of ensuring constant speed would be to fit a governor of the gramophone type either on the motor or worm shaft, but such close control is hardly necessary for a job of this nature, and it would be a needless complication. The entire mechanism, and preferably the chimes as well, should be protected from dust as far as possible and may be completely enclosed in a box, but this should have a fret, with fabric backing, at the front, to avoid muffling the sound; an old radio cabinet is an obvious means of enclosure, and can often be obtained quite cheaply.

Construction

It is more than likely that the model engineers' treasure chest—in other words, the junk-box, will provide many items which can be pressed into service, and this may involve the need for some modification of the details. If the constructor is, like myself, a haunter of the "surplus" markets, and an incurable collector of ingenious bits of mechanical bric-a-brac, it is possible that some fearfully and wonderfully conceived aircraft instrument, which was bought without knowing either its original purpose or its final destiny, will yield gears, springs, contacts, screws and what-have-you galore. This is all to the good, so long as one always keeps junk in its proper status as a servant to the model engineer, and not his master.

The motion plates for the mechanism are among the first items to be considered, and details of them are given herewith. They are made out of 14-gauge sheet metal, and traditionally, should be of hard brass, but this metal is expensive, and not easy to come by these days, so it might be found necessary to use a substitute. I have employed duralumin (more war surplus) in the present case, and so far as can be ascertained at present, it appears to be entirely satisfactory; it is probably quite as good a bearing metal as brass, and only its appearance might possibly be objected to. The plates should be absolutely flat, and if this is likely to entail any considerable hammering, it is advisable to anneal them. In the case of duralumin and similar alloys, care must be taken to avoid overheating, and as it cannot be made red-hot, the usual visual indications of temperature cannot be adopted. For industrial treatment of these metals, salt baths, so compounded that they fuse at a definite temperature are employed, but this method is not usually available in the home workshop. The next best thing is to mark the surface of the material with ordinary household soap, and heat it over a Bunsen burner or blowlamp till the soap carbonises and shows black marks, then quench immediately in water. Forming or any other cold working should then be carried out immediately, as the alloys have the property of age-hardening automatically in a short time. While this information may be ancient history to many readers, I find that many amateurs do not know of the peculiar properties of light alloys, and encounter difficulties in working them as a result, so a word on the subject will not be entirely superfluous.

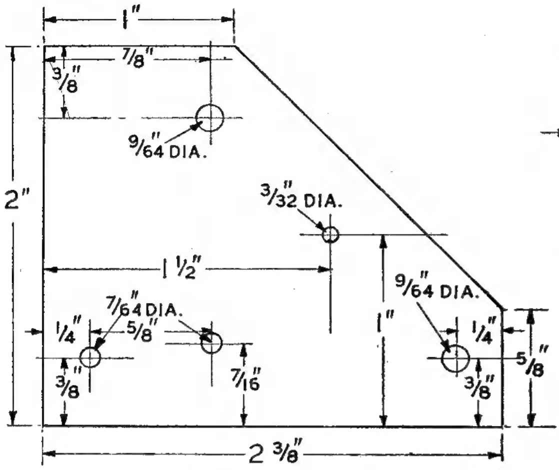
Having ensured that the plates are quite flat when tested on a surface-plate or machine table, they may be cleaned up on the surface, any hammer marks or other blemishes being removed with a file and scraper, followed with emery cloth and oil, working in one direction to produce a "straight grain," but final finishing should not be attempted at this stage.



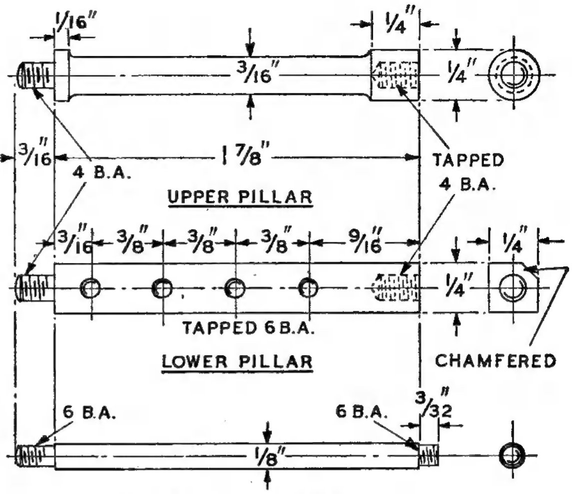
BACK MOTION PLATE

Alignment of Holes

The positions of the holes in both plates are shown on the drawing, and it will be seen that several of these have to be accurately aligned, so that it is advisable to clamp the two plates together while spotting



FRONT MOTION PLATE



HAMMER REST & PIVOT

them with an undersized pilot-drill. Some of the holes in the backplate, such as those for the motor mounting, may be marked off or spotted from the actual component; it is advisable to defer the drilling of the holes for the worm shaft bearings until after the worm wheel is cut, as some adjustment of mesh may be found desirable.

Incidentally, some readers may wonder why the gearing is not arranged so that the motor drives directly to the worm wheel on the pin-barrel, as this would appear to simplify construction by the elimination of a pair of gears and a shaft, with its bearings. As a matter of fact, the original intention was to adopt such a layout, but it did not work out so well in practice as one might expect. In the first place, it involved the necessity of making an extension to the motor shaft, either fixed or through a loose coupling, with a correctly aligned outboard bearing. This would not be an insuperable obstacle, but a further trouble was that it destroyed the neatness and compactness of the assembly, which looked lopsided and gawky. The skew gears employed have a ratio of 2 to 3, which in conjunction with the 72-toothed worm gear, give a final reduction of 108 to 1 to the pin-barrel. There are plenty of similar skew gears available on the surplus market at low prices, and it should not be difficult to obtain a pair to suit the purpose. If, however, it is found necessary to use gears of a different ratio to that specified, the ratio of the worm gear should be modified to give approximately the same total reduction, the aim being to produce one revolution of the worm wheel in about 2 sec. or thereabouts, under working load.

It may be mentioned that although the particular gear fitted to the worm-shaft was obtained with a central hole 5/32 in. diameter, and could, therefore, be fitted to the shaft without difficulty, the one for the motor had a solid centre, being formed integral with a short shaft, and after cutting off the latter, had to be drilled and reamed ⅛ in. diameter. It was mounted truly for this operation by boring out a brass bush in the self-centring chuck, a push fit for the outside of the gear, which was then inserted and held firmly by closing the chuck jaws a little tighter so as to distort the bush. A centre-drill was first used to start the hole accurately, followed by a No. 31 drill, and a broach made from ⅛-in. silver-steel by filing off the end at an acute angle, hardening and tempering.

Pillars

Two main pillars are used to hold the motion plates together (or should it be apart ?), one being made from round brass or dural rod, and the other from square rod, the object in the latter case being to enable the return leaf-springs to be attached on the underside. It would, of course, be permissible to use round rod of larger diameter, with a flat filed on it, as an alternative. The necessity for these springs may be questioned, and the hammers will certainly work without them, but they promote a more nimble action, and produce a louder tone. It will be noted that a chamfer is formed on the upper corner of the pillar, so that it is well clear of the worm wheel, but this need only be local, and may not be found necessary at all; it is specified, however, in case the gearing may be modified, necessitating an oversize worm wheel.

The two pillars should be made exactly the same length, from the rear and face to the shoulder. They are drilled and tapped at the rear end to take 4-B.A. screws, instead of being shouldered down and screwed at both ends, as might be considered more logical and workmanlike. The reason for this, is that it is undesirable to have any projections behind the backplate, in view of the particular method of mounting the mechanism in its case which has been adopted. The clearance holes for the pillar screws in the backplate are, therefore, countersunk from the outside, and fitted with countersunk screws.

Two other rods pass between the motion plates and provide some additional support; these are made from ⅛-in. steel rod, turned down and screwed 6 B.A. at each end, the effective length between shoulders coinciding with that of the pillars. One end of each is screwed firmly into the back plate, the other passing through clearance holes in the front plate, and secured by a nut. The outermost of the two rods forms the support on which the hammer-rods rest when they are not being lifted by the pins in the barrel; it should be sleeved with a piece of thin rubber tubing to avoid noise and provide resilience. Its companion forms the working pivot for the four hammers.

(To be continued)

THE INVENTIONS EXHIBITION

TO view in true perspective an exhibition of modern inventions and new ideas, one must not only have some appreciation of the nature of invention, but also an insight into the mind of the inventor. Otherwise, one might be somewhat disappointed to find that it does not bristle with startling and revolutionary devices straight from the lurid pages of the science-fiction magazines, such as space rockets, atomic-power engines, or machines for extracting gold from sand. In contrast, the actual exhibits, such as a domestic egg-boiler, a reversible window, or a direction indicator for cyclists, may appear unromantic, but they are none the less definite contributions to practical progress, which in time may come to affect our lives in ways we little expect. The creations of the inventor represent the future in embryo, and we can no more make a hard-and-fast forecast of their future value than anyone, seeing an egg for the first time, could predict that it would develop into a chicken.

The recent exhibition at the Central Hall, Westminster, the first of its kind since 1938, provided much food for thought, to anyone capable of appreciating the important part which has been, is, and will be played by inventions in all aspects of modern life. As might be expected, a large proportion of the inventions exhibited were of a domestic nature, including cooking utensils, heating, lighting and ventilating appliances, and furniture. To the housewife, such items as a rotary service hatch, for transferring food from kitchen to dining room, a window that can be turned inside out for cleaning, an electrically-heated draining board, and a shoulder-suspended washing basket which leaves both hands free, cannot fail to have an instant appeal.

The inventor of a modernised spinning wheel and a simple hand loom demonstrated the practical value of these devices, not only by the work carried out on the spot with them, but also in the homespun suit he was wearing, both the texture and pattern of which were a credit to the weaver.

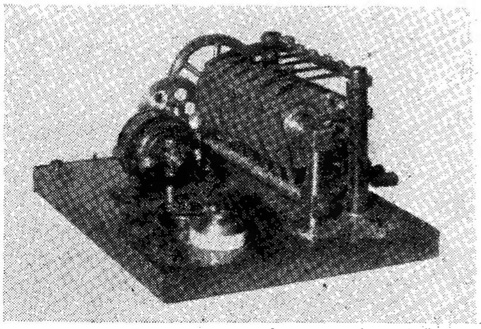
Tools and hand appliances included several new types of spanners and wrenches, garden shears, an ingenious quick-release clamp, and a bevel gauge attachment for a handsaw. One inventor had tackled a common problem which seems to have been passed by in the march of mechanisation ; namely, the digging of holes for gate and fencing posts. He also demonstrated a practical stake-driving appliance with a " captive " hammer, which should effectively kill the evergreen joke of the navvy who misses his target and hits his mate's thumb !

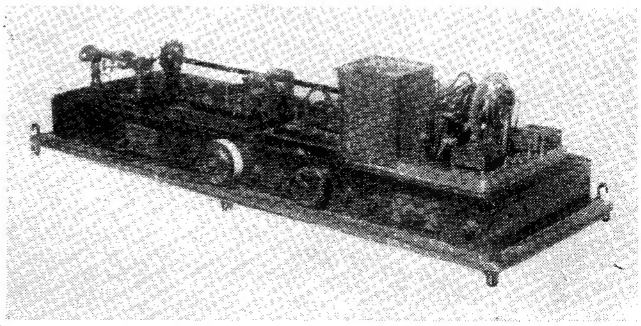
Agricultural appliances included a new type of potato harvester, trials of which are giving good results. Among power appliances may be mentioned a flexible-shaft driven percussion hammer, enabling considerably more force to be applied to the tool than is possible with either the hand-operated type, or that which incorporates a self-contained motor. A mechanical conveyor system was exhibited, suitable for factory use or other purposes, incorporating an ingenious type of folding chain. Transport exhibits included a new type of fabricated vehicle wheel, and several devices of interest to cyclists, such as automatic stop lights, direction signals, and transmission gears ; a new " safety " cycle of distinctly unorthodox design was also shown.

A very ingenious and practical device was the infinitely variable transmission unit, suitable for motor-cars or other purposes, which eliminates the need for gear changing, and should promote simpler and safer motoring. Another noteworthy mechanical exhibit was the machine for attaching handles to cups, an operation which has hitherto required skilful and relatively slow hand manipulation.

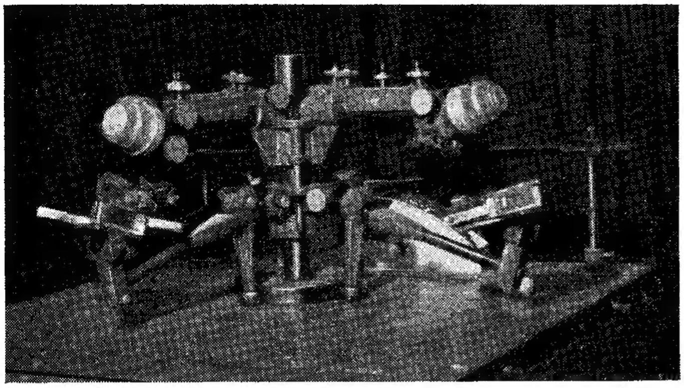
Several new inventions which have already established themselves in industry were exhibited, such as those featured by the General Electric Co. Ltd., which include a process of cold welding which appears to have far-reaching possibilities, a layer thickness meter, and a magnetic sorting bridge in which the properties of the cathode ray oscillograph are utilised to compare the metallurgical and dimensional accuracy of samples, in a way that savours of black magic. Oscillographic applications are also featured in appliances by Messrs. A. C. Cossor Ltd., X-ray apparatus by Messrs. Watson & Sons Ltd., and dielectric heating by Electric and Musical Industries Ltd. Messrs. Siebe Gorman Ltd., showed a self-contained shallow-water diving outfit, and Messrs. Accles and Pollock Ltd., exhibited specimens of micro-bore and multi-bore tubes, including the smallest tubing in the world, with an outside diameter of 0.00175 in. and an inside diameter of 0.0005 in.

The exhibition was opened by Professor A. M. Low, who is himself

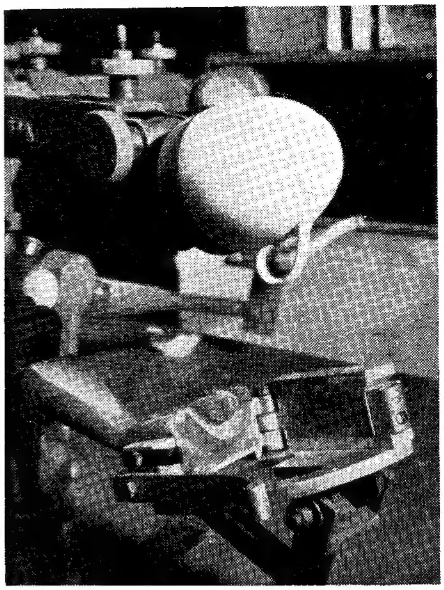




The transmitter and receiver of Professor Low's original guided missile



The Strasser cup-handling machine



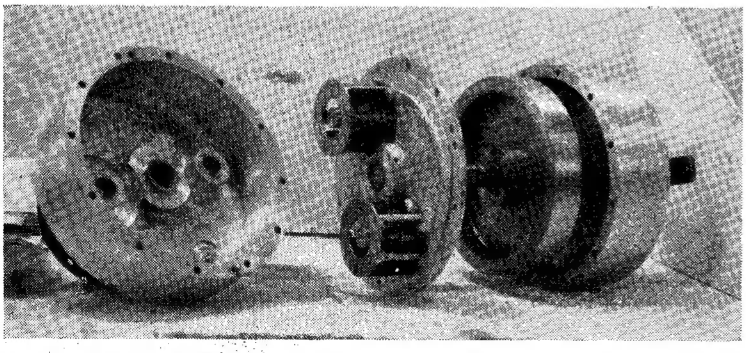
Right—A close-up of the Strasser machine after the handle has been fixed and the die opened

an inventor of no mean distinction, and has been a pioneer in the development of radio, television, sound measurement, and guided missiles. He emphasised the value of invention, particularly at the present time, when this country relies for its very survival in keeping in the forefront of engineering and scientific progress. British inventors have led the way in many of the most important inventions of the past, and are proving that they are still capable of doing so. The lot of the inventor is not, in many cases, a happy one, and it is only in some rare cases that he reaps the merited reward of his enterprise, which sometimes amounts to his life's work. At the present time, things are more difficult than ever, because the existence of a "seller's market" made manufacturers reluctant to take up new ideas, and the inventor was apparently regarded by tax assessors as fair game. Professor Low expressed the opinion that the exhibition had an importance out of all proportion to its size or glamour. He referred to the historic occasion when Michael Faraday demonstrated the production of an electric spark by electro-magnetic means to Mr. Gladstone. "Very clever," said the great man, "but what use is it?" "Don't worry," replied Faraday, "one day you'll be able to tax it!"

The great work of Faraday was suitably represented at the exhibition by a replica of the coil of wire which he first demonstrated the phenomena of electro-magnetic induction. It is safe to say that nobody at the time, seeing such a simple, indeed crude, piece of apparatus, could have foreseen that from it would develop the mighty electrical power plants of the twentieth century. Another historical relic, also capable of pointing a moral, was the actual control gear of the world's first guided missile, or "aerial torpedo," which was designed by Professor Low, and successfully flown in 1917. It may be of interest to note that the general working principles of this apparatus are basically similar to those which are applied by many of our readers in radio-controlled models at the present day.

It may perhaps be permissible to observe here that, from the model engineer's point of view, the construction of several of the models or prototypes of inventions exhibited were open to some criticism; no doubt this was excusable in the circumstances, but none the less regrettable. One of the inventor's greatest practical difficulties is the interpretation of his idea in concrete form; his efforts to do so himself are often crude, and models made by others—quite apart from the great expense usually involved—often fail to capture the true spirit of the invention. We would urge that every inventor should seek to equip himself with the manual skill and craftsmanship to undertake competently the construction of his own prototypes, and there is no better way of doing so than by taking up model engineering. Our fraternity are well known for their interest in anyone with new ideas, and their helpfulness in solving practical problems, and the inventor may be quite sure of finding kindred spirits and willing helpers among us.

The inventions section of the exhibition was under the direction of the Institute of Patentees, Inc., 207-208, Abbey House, Victoria Street, London, S.W.1, to whom any enquiries regarding commercialisation of the inventions, or other details concerning them, should be addressed.



The internal components of the McGill-Langford automatic transmission gear

Talking about Steam—

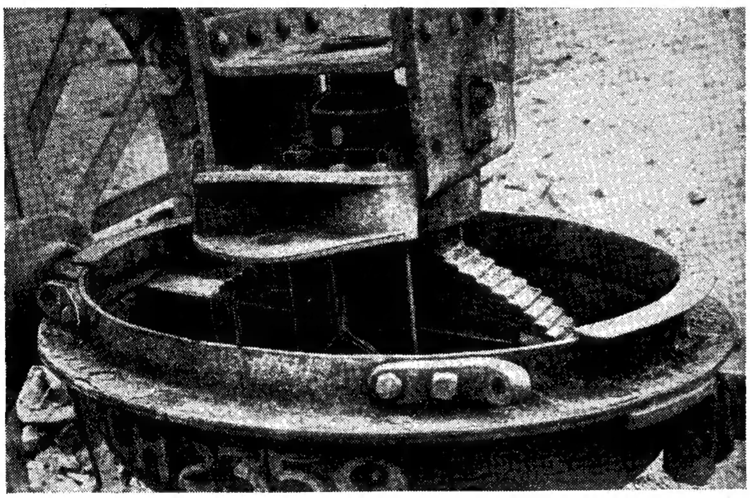
NO. 16. THE FOWLER "BIG LION" ROAD LOCOMOTIVE

By W. J. HUGHES

I HAVE already included in this series (November 13th, 1952) a perspective sketch of the assembly of the front axle, with its appurtenances, of the "Big Lion," and now here are some scale drawings to go with it. Once more I am grateful to our friend Stan Green, of Calgary, for supplying the original pencil drawings. Actually, I have altered these slightly, because Stan has made an error in the collars. He has made them $1\frac{1}{8}$ in. in diameter, with the wheel hubs butting up to them, whereas, in fact, the inside face of the hub should be bored out to fit *over* the hub collar, presumably as a mud seal. (See Photograph No. 30 by The Press Photo Agency, of Sheffield).

Fig. 69 shows the axle with its collars, which are built up as follows : A piece of $\frac{1}{2}$ in. by $1\frac{1}{8}$ in. mild-steel bar is roughed out to shape, and the ends turned between centres to $\frac{1}{2}$ in. diameter. Collars, $\frac{3}{4}$ in. by $\frac{3}{8}$ in. thick, are silver-soldered on, as shown in Fig. 70, and the shaded part is milled away, including the surplus 1/32 in. on the front and back of the axle, to bring it to the required $\frac{7}{16}$ in. thickness.

The axle is then again mounted between centres, the wheel seats turned to $\frac{7}{16}$ in. diameter, and collars faced and turned to $\frac{11}{16}$ in. diameter. The axle is finally finished to shape between the collars by filing.



Photograph No. 30. Forecarriage of "Lord Kitchener," Fowler No. 9292, now scrapped. Rollers are missing from ends of spring

Front Spring

At the time of writing the November 13th article, it was intended to include the picture of the forecarriage details now reproduced as Photograph No. 30, but although I searched high and low for it, it could not be found. However, it has now turned up (when I was looking for something else, as is usually the case !) in time for this article, and it should be useful to builders of a little "Big Lion"—if this term is not too contradictory. It has been given before, a few years ago, but I make no excuse for reproducing it again.

If you compare it with my perspective drawing (Fig. 39), it will be seen that the rollers under each end of the spring are missing, but the downward projecting lugs which supported the rollers are there. Details of the spud pan construction may also be seen.

There should actually be twelve leaves in the spring, but Stan has used ten, as shown in Fig. 71. They are of 3/64-in. spring steel, $\frac{7}{16}$ in. wide, and the lowest one has the lugs formed on it, of course. The second one is the same length, $3\frac{7}{8}$ in., and each successive one is $\frac{3}{8}$ in. shorter. In this country the

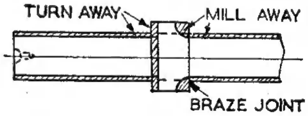


Fig. 70. How to fit the axle collars. Part shown shaded machined away after brazing

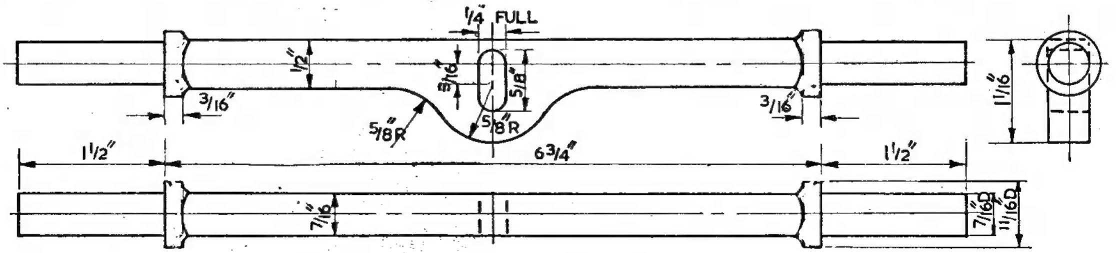


Fig. 69. Front axle for $1\frac{1}{2}$-in. scale "Big Lion"

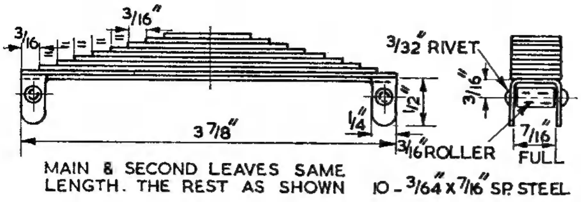


Fig. 71. Front axle spring and rollers

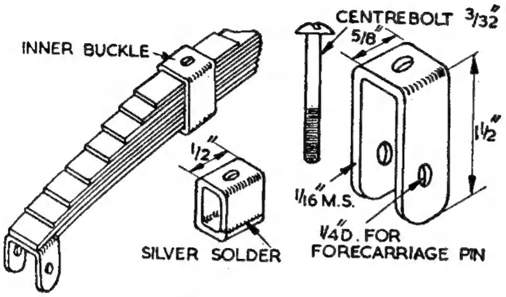


Fig. 72. Stan Green's spring and buckle : a modification is suggested in the text

nearest gauge available is No. 18 s.w.g.—only a few thou. different, 0.048 in.—and the ten leaves would total a thickness of 31/64 in., minus a gnat's whisker.

As shown in the sketch, Fig. 72, Stan has used a separate buckle for his spring, brazed up from 1/32 in. thick mild-steel, but I think that it could well be formed as part of the inner fork itself, as in Fig. 39. This would reduce the overall width of both inner and outer forks by $\frac{1}{16}$ in., of course, and enable the latter to be more true to scale.

The spring has been given an initial camber of about 3/32 in., which it *may* prove desirable to adjust when the engine is complete, with the full weight up. It would be difficult to give a definite figure for this, as quite a lot would depend on the quality and temper of the steel used.

Boiler

The next drawings should be *very* useful to any reader building the B.6, being taken from Stan's drawings of his boiler. But first a word about the hornplates.

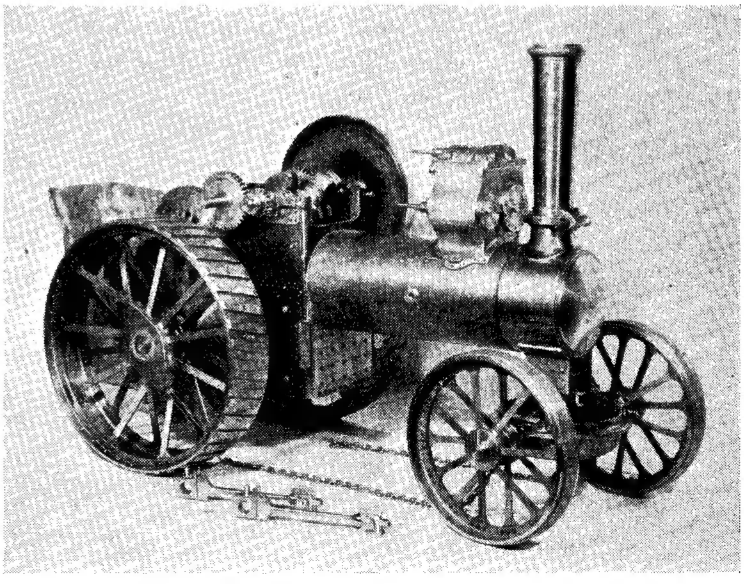
As has already been pointed out in this series, the hornplates in prototype practice are really the side-sheets of the external firebox itself, extended upwards and backwards to carry the bearing-brackets for the shafts. Of course, anyone building a steel boiler could use this method, but where a copper boiler is being used, it is more than doubtful if copper hornplates would have the necessary strength and rigidity, unless made with a very much over-scale thickness which would spoil the appearance of the whole engine.

The usual practice, then, is to build the boiler entirely of copper, and to affix separate steel hornplates to the firebox sides. Various methods of attaching the plates have been used, including screws passed through them and tapped into the copper ; extended firebox side stays, with nuts outside the plates : and so on.

The method Stan has used is one suggested in my book ; namely, to make some of the stays hollow, and to pass nuts and bolts right through, with the nuts either inside the firebox or outside the plates. In his case, he has used five $\frac{1}{8}$-in. bolts to each plate, only two of which are at all noticeable. You will note in Photograph 31, of course, that he has put dummy rivets and stayheads in the plates where they would be in the prototype. (In parenthesis, I hope to do away with bolts entirely in my Allchin boiler, but time, and experiment, will decide.)

As will be seen in the end elevation of the boiler (Fig. 74), the sides of the firebox are set in $\frac{1}{16}$ in., which brings the heads of the hollow stays level with the external diameter of the boiler barrel. Fig. 75 shows the stays themselves.

Now a model traction-engine boiler has to be stronger structurally than that of a railway locomotive, for obvious reasons, and so the barrel should be of a thicker gauge than might be used for a locomotive boiler of the same size. In this case it is 13-gauge, and with a diameter of $3\frac{3}{4}$ in. it so happens that this is the same as specified for the Allchin "M.E." traction-engine. At the time of writing, Bro. Reeves hasn't this in stock, but it has been on



Photograph No. 31. Stan Green's Fowler keeps on growing—a recent photograph

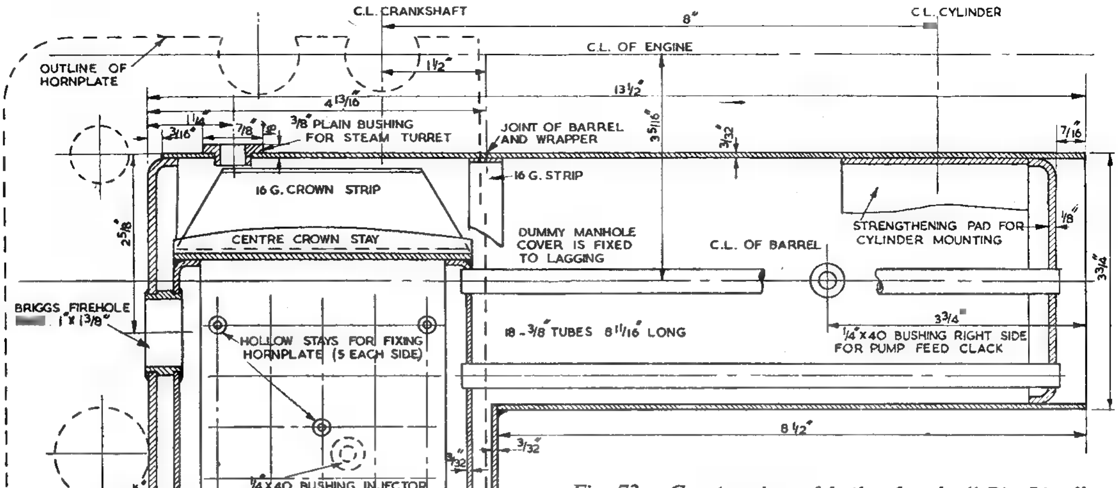
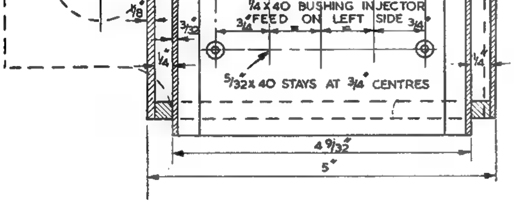



Fig. 73. Construction of boiler for the "Big Lion"

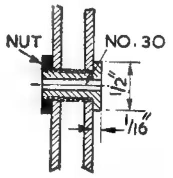


Fig. 75. Hollow stay for securing horn-plate

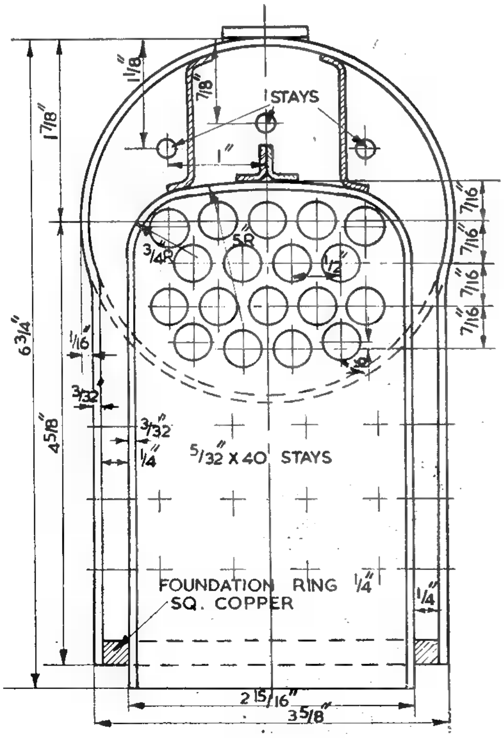


Fig. 74. Cross-section of boiler at firebox. Note set in of wrapper at each side.

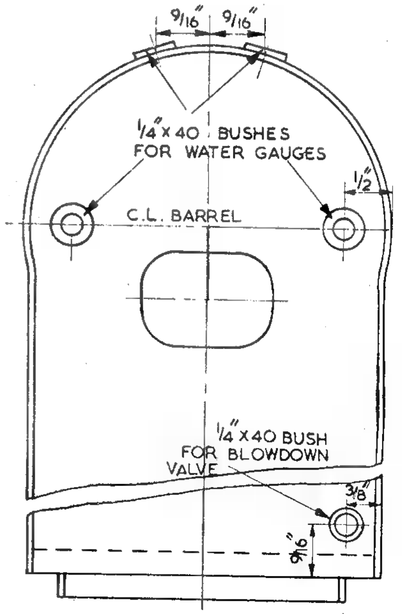


Fig. 76. Layout of bushes on front plate

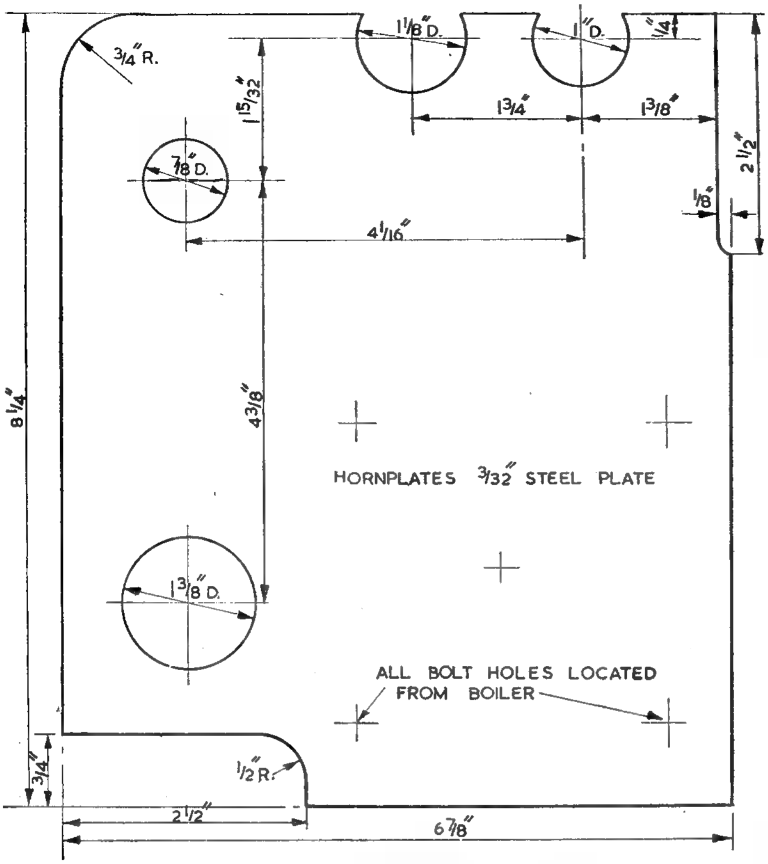


Fig. 77. Dimensions of hornplate

Three solid longitudinal stays are fitted, ¼ in. diameter, and the hollow firebox stays are screwed in 5/16 in. by 40. As shown, they have a turned head outside and are lock-nutted inside. The solid firebox stays are 5/32 in. by 40, lock-nutted inside and riveted over outside, and are at ¾ in. centres.

Construction of the boiler is on approved "L.B.S.C." lines, and need not be detailed here. One thing does need to be emphasised, however: it is highly important to work accurately and to keep everything square and in line. Otherwise you may quite easily find the cylinder out of line, or the motion out of square, when the time comes to erect the engine. *Verb. sap* !

Hornplates

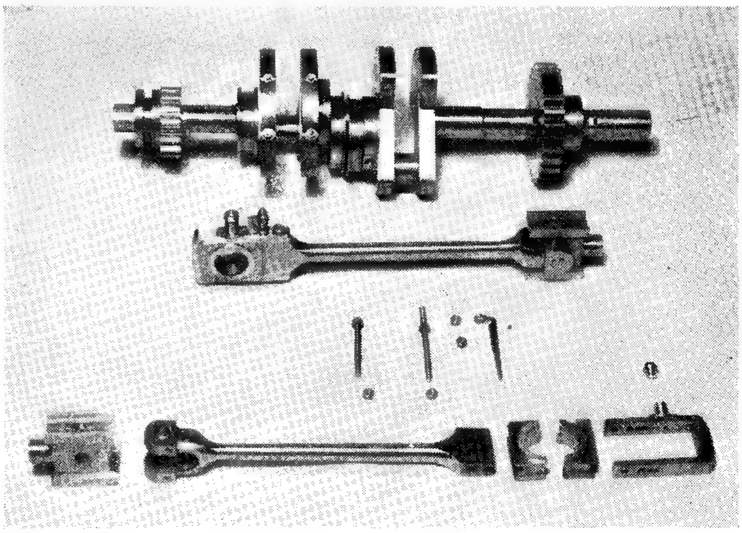
To be dead to scale, the hornplates should be 5/64 in. thick, but, as in the Allchin, perhaps we might take the liberty of increasing this to 3/32 in., without unduly upsetting Inspector Meticulous. (I hope "L.B.S.C." doesn't mind my occasional use of words and phrases which are almost his copyright, but I've been reading his articles so long that said phrases seem to fall naturally from the old ball-point !)

The outline of the hornplates is given in Fig. 77, again from Stan's own drawing. There isn't a lot to say about these, except that great care is needed in marking-out and working the openings for the shaft brackets. Similar care will be needed in fitting the plates to the boiler,

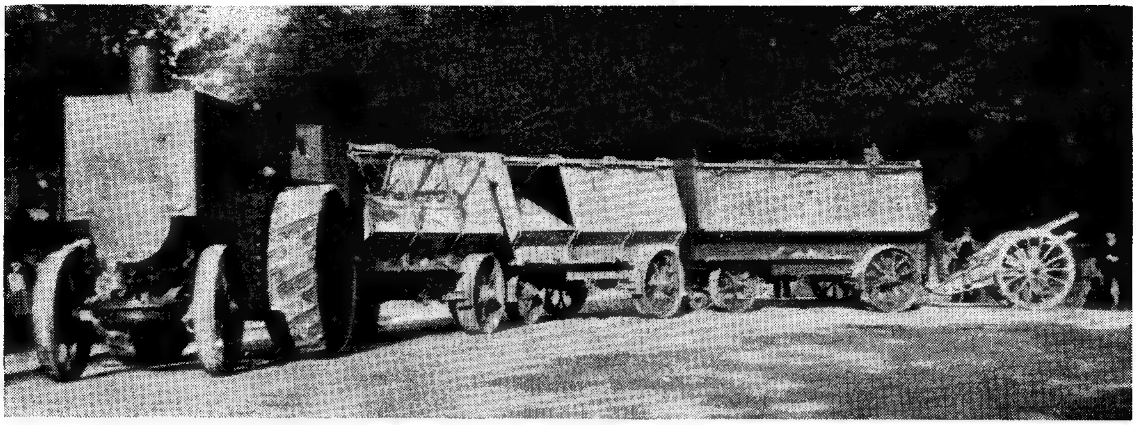
order for a long time, so it shouldn't be long now (we hope !). But it's good to know that it will be available for both engines.

The smokebox tube-plate and the front-plate are both ⅛ in. thick (10-gauge), all the other plates being 13-gauge. There are eighteen ⅜ in. dia. fire-tubes, and with a grate area of nearly a square foot it is my guess that the difficulty will be to keep this boiler from blowing off ! Incidentally, Stan has tested his boiler to over 225 p.s.i., so it should do the job required of it.

A bush tapped ¼ in. by 40 is placed in the right-hand side of the barrel for the boiler feed from pump, and a further one, for the injector feed, is fitted at the left-hand side of the firebox. Similar bushes are fitted to the front-plate for the blowdown valve and the lower fittings of the water-gauges, and to the top of the wrapper for the upper gauge fittings. See Fig. 76. The bush for the steam turret is plain, as shown.



Photograph No. 32. More bits and pieces, showing construction of a strap-and-cotter big-end



Photograph No. 33. Fore-runner of the tank—a Fowler armoured train built for the South African War

in order to make sure that the motion lines up correctly.

Photographs

Two more recent photographs of the Canadian Fowler are given this time, having been taken on January 25th this year. It will be seen from No. 31 that the tender is coming along nicely, and the gearing shows up well, too. The second (fast) speed pinion, however, is apparently not fixed to the crankshaft yet, nor on this photograph are the third (extra fast) speed gears fitted.

However, in Photograph No. 32 both the slow and extra fast pinions are shown in place on the crankshaft. It will be recalled that both these pinions slide on the crankshaft, whereas in the second speed the pinion is fixed and the spur wheel slides on the second shaft.

You will also note in this photograph that Stan has made the big-ends of his connecting-rods with pukka split bushes and taper cotter. Very nice they look, too ! Incidentally, our Canadian friend is no mean hand with a camera, is he ?

Photograph No. 33 is an interesting historical photograph, for which I am grateful to Mr. T. D. Walshaw. It shows an armoured Fowler road locomotive and train, hauling a howitzer (I hope that's the correct name—artillery is not my strong point). I understand that several of these trains were built for the South African War, although under a hot sun and with the heat of the boiler as well, one imagines that the occupants of that enclosed cab would be well grilled ! Even so, with a battle raging, it might be cooler in than out !

The armoured wagons, of course, were to protect the gun crews and ammunition, and in another photograph I have, a gun is shown in one of the wagons, having been run up a ramp, presumably with the aid of the locomotive's winding-rope.

In parenthesis, it is interesting to recall that the very first " tanks " were built by another famous traction-engine firm, Foster's of Lincoln.

PLASTIC BELTING

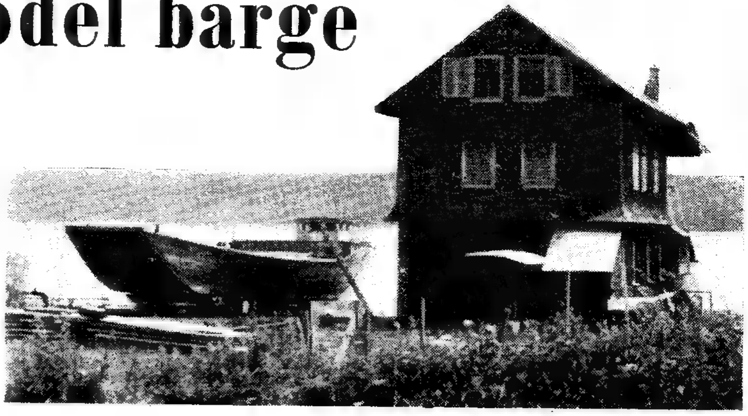
THE need for efficient light belt drives is frequently encountered in the small workshop, particularly in connection with milling and drilling attachments to the lathe, and the usual materials used for belting, such as leather, gut, or rope have hitherto been applied with a certain amount of success. They have several disadvantages for this particular class of work, however, including inability to vary the distance between driving and driven shafts, except by the use of jockey pulleys with automatic tension devices, and also the difficulty of making really satisfactory joints. In the " M.E." workshop, experiments have been in progress for some years with a form of plastic belting which eliminates these disadvantages, and also enables increased torque to be transmitted for a given size of belt and pulleys. The material found most satisfactory is a special grade of " P.V.C." (polyvynil chloride), but unfortunately it has been found extremely difficult to obtain this grade in substantial quantities, and only small sample lengths have been available.

We are now able to inform our readers that P.V.C. belting of an appropriate quality has now been put on the market by Mr. K. Whiston, of 8, Watford Bridge Road, New Mills, Stockport, Lancs. Samples which have been submitted to us have proved satisfactory on test and similar in physical properties to the material which has been demonstrated in the " M.E." workshop. The elasticity of the material is sufficient to enable it to be used for drives in which the centre distance, due to the feed movement of the spindle, varies considerably, while still retaining an efficient grip on the pulleys. Jointing is extremely simple, as it can be welded by application of a hot iron (a little below soldering temperature) to each of the ends, which are then butted together, and held in place for a few seconds. The " flash " is then trimmed off, and the result is a virtually endless belt; consequently, the noise and jarring of belt fasteners is eliminated. This belting is available in $\frac{1}{4}$ in. and $\frac{5}{16}$ in. diameter (round) at present, and these sizes cover the majority of small workshop requirements, but other sizes are under consideration.

Mr. Whiston is already known to MODEL ENGINEER readers as the supplier of innumerable workshop sundries, some of which are unobtainable elsewhere. These include ex-aircraft bolts, nuts, screws, washers, springs, etc., in a wide range of sizes, electrical and mechanical instrument components, and a variety of assorted lots of useful materials. New lists of these supplies have been issued recently, and readers who have not already done so will find it well worth while to get their names included in Mr. Whiston's mailing list without delay.

A Swiss model barge

By Alb. Kruck (Zurich)



A " Ledischiff " in for repair at the upper part of the lake of Zurich

SOME years ago, while trying out my model steam boat under power in a tank, my son watched me with great interest. No wonder then that he expressed his wish to own such a ship himself. What father could have refused ?

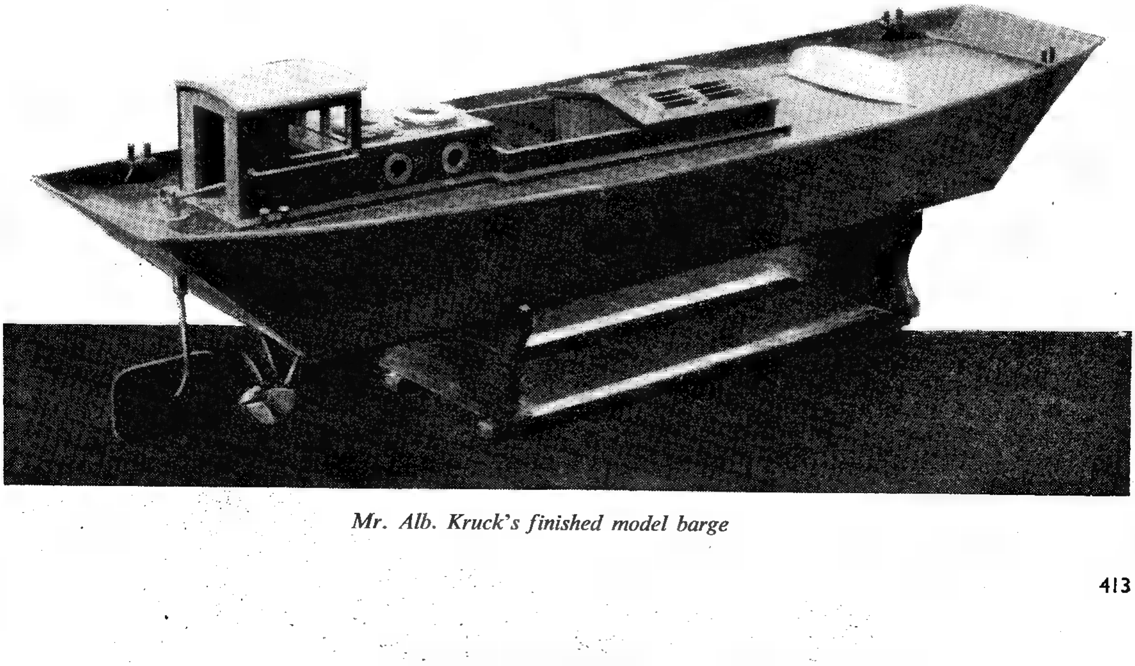
It so happened that at that time the plumber had to replace the iron sheeting plating on our roof, and he very kindly let me have a spare sheet of well-preserved galvanised iron.

However, at first I had not decided the shape of the prospective model ship I had in mind to construct for my boy. After a while, I hit upon the idea of giving it the form of our local freight-motor-barges. These barges, called " Ledischiff ", are well known by all inhabitants of the many villages which are situated round the 20 miles long lake of Zurich. The characteristic noise of their rather slow, heavy ticking of motors is well known by all people, young and old, and this fact is very useful especially at night, and still more so when a thick fog is on the lake that envelops everything and limits any sight to very short distances. These motor-barges transport gravel, sand or stones from the upper part of the lake of Zurich to Zurich and the several villages around for house-building, roads and other kinds of constructions. These materials may, thousands of years before, have been parts of the big mountains of the Todi district and its neighbours. The glaciers and mountain torrents had, no doubt, washed down to the valleys these valuable materials.

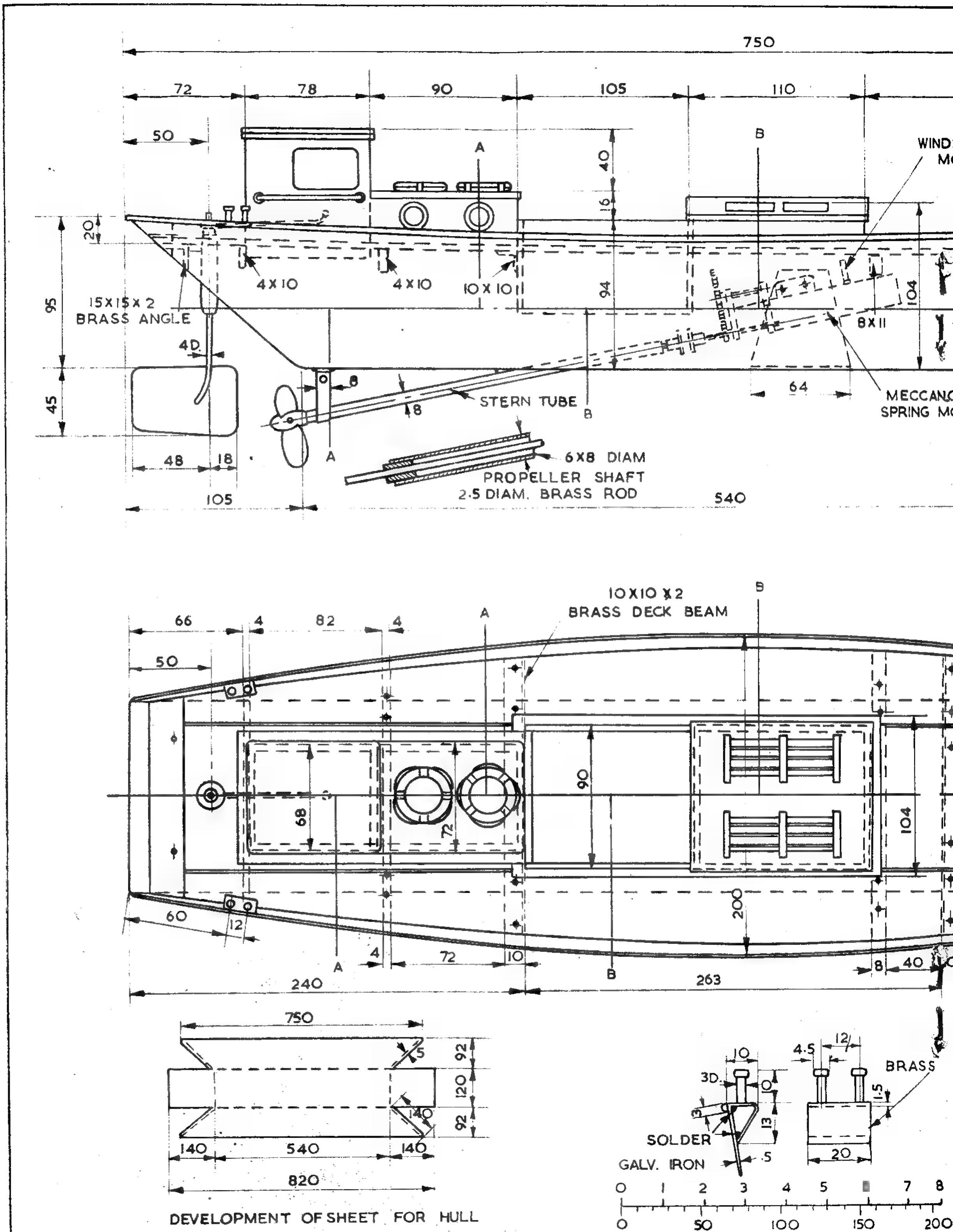
The hull of the model ship was very easy of construction. First I cut out of the piece of old tin-sheet the pattern as seen in the large drawing. The lateral parts were bent upwards, then those of the front and the back. The overlapping edges made soldering a comparatively easy task and at the same time strengthened the hull. After soldering, I pressed the sides into shape with my thumbs in such a way that the largest breadth in the middle amounts to 200 millimetres. In order to attain a perfectly even line on both sides I cut a stencil out of cardboard. Then, I soldered the two middle deck-beams consisting of angle brass 10/10/2 millimetres, to the lateral parts of the boat. Equally, two angle brasses 15/15/2 mm., are soldered to the front and back parts, and serve to support the deck, and at the stern the sleeve for the rudder. Measurements are indicated in the drawings.

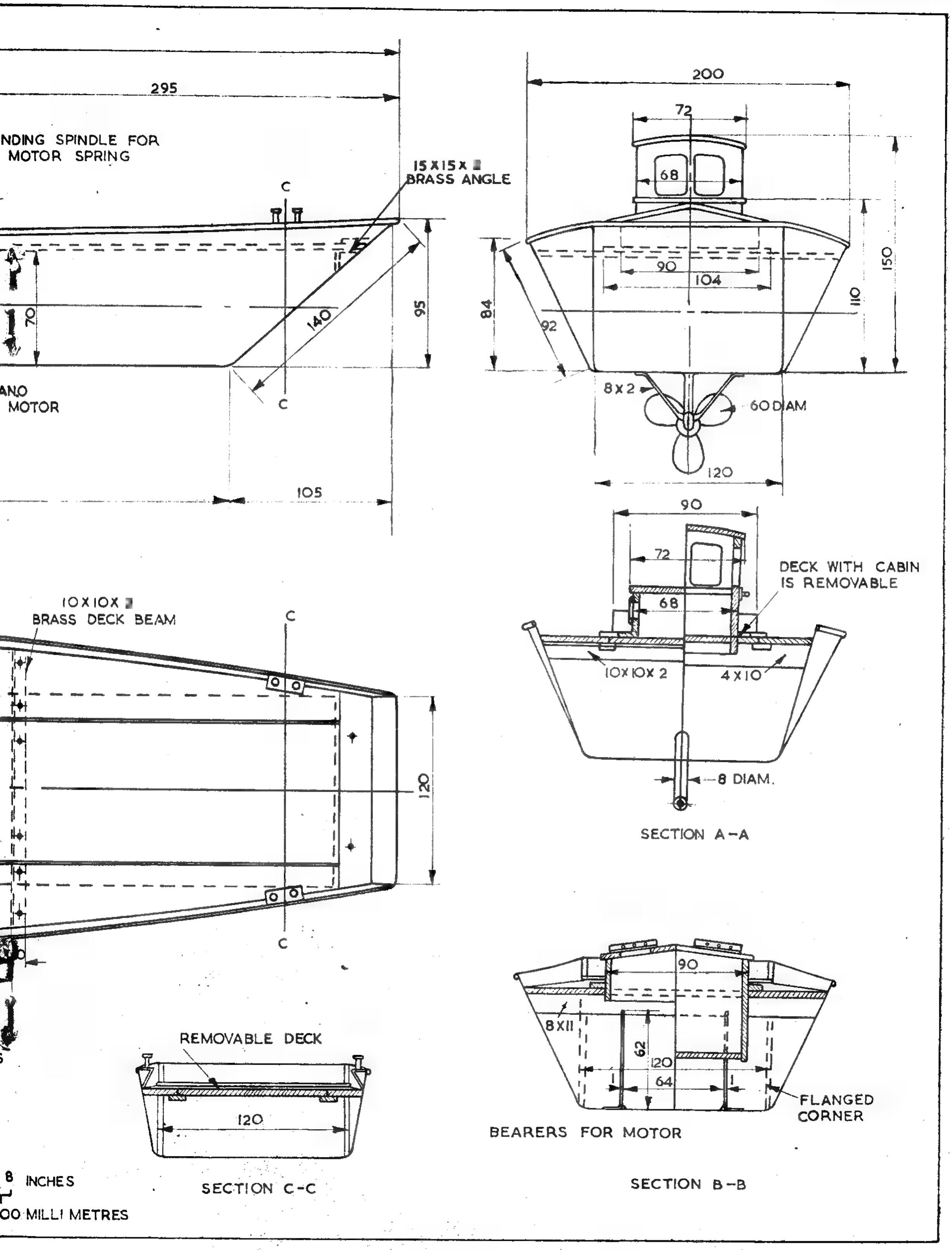
The stern-tube with its two bearings together with the " A " bracket is soldered to the body of the boat. For a channel or gunwale, a half-round brass rod, 3/2 mm. wide is also soldered on to the upper edge of the side, front, and back parts.

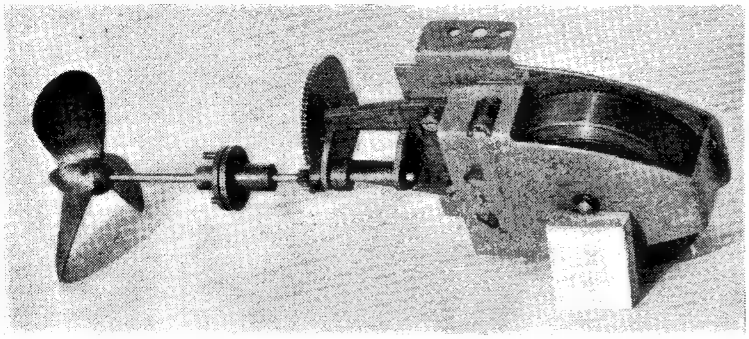
The deck, as well as all above-board constructions, are made out of nutwood. The thickness of wood



Mr. Alb. Kruck's finished model barge


750
15X15X2
BRASS ANGLE
STERN TUBE
6X8 DIAM
PROPELLER SHAFT
2·5 DIAM. BRASS ROD
MECCANO
SPRING MO
10X10X2
BRASS DECK BEAM
SOLDER
GALV. IRON
BRASS
DEVELOPMENT OF SHEET FOR HULL

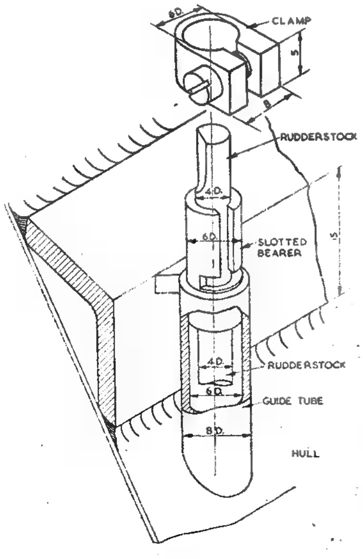

295
NDING SPINDLE FOR
MOTOR SPRING
15 X 15 X
BRASS ANGLE
C
70
140
95
ANO
MOTOR
C
105
200
72
68
90
104
84
92
110
150
8 x 2
60 DIAM
120
90
72
68
DECK WITH CABIN
IS REMOVABLE
10 X 10 X 2
4 X 10
8 DIAM.
SECTION A-A
10 X 10 X
BRASS DECK BEAM
C
120
C
REMOVABLE DECK
120
SECTION C-C
90
8 X 11
62
120
64
FLANGED
CORNER
BEARERS FOR MOTOR
SECTION B-B
8 INCHES
00 MILLI METRES



Underneath view of the spring motor for the model barge

is everywhere 4 mm. Connections between all parts of wood consist of small brass wood-screws, with countersunk heads. Where the deck comes to rest on metal angles, 2 mm. metal-screws were used. These also had countersunk heads. Everything else in connection with the upper construction should be obvious from the drawing and photograph.

The screw propeller is driven by a "Meccano" autospring motor. I should very much have liked to build in a boat spring-motor (Bassett-Lowke), specially constructed for the purpose. I had, however, to be glad to obtain anything suitable at all during the war. The applied spring-motor was too powerful for direct propulsion of the screw and would have driven the boat faster than scale speed compared with the original. The real freight boats are slow of motion. Considering their tonnage (from 60 to 250 tons) the engines are weak and the boats are comparatively slow. In order to adapt the speed of my model to that of the original, I fitted a cogwheel contraption into the spring-motor, as seen on the photographs. Increasing the gear ratio between the propeller and the spring-motor resulted in a longer running time. The latter amounts to about 12 minutes. Unfortunately, I have no photograph of the moving boat. Its reduced velocity, however, makes a more realistic impression. The way the spring-motor is built in, can again be seen from the drawing.



Detail of rudder stock, bearing and clamp

Rudder Details

The rudder is put through a tube with two bearings (as in the stern-tube). The upper bearing is cut open as is shown in perspective on the detail drawing. A clamp allows of fixing the rudder in such a way that it can be moved by hand, but does not change its position while the boat is in motion.

After the bollards (see drawing) had been soldered to the hull, I started on painting the boat. The exterior part of the body above level of water was covered with an enamel (colour, brown) like wood. Below level of water the boat is green. The interior below deck received a grey coating. All above-board constructions, including the deck itself, were varnished in natural colour after everything had been rubbed off with glass paper. Only the roof of the pilot-house is white. The bollards are black.

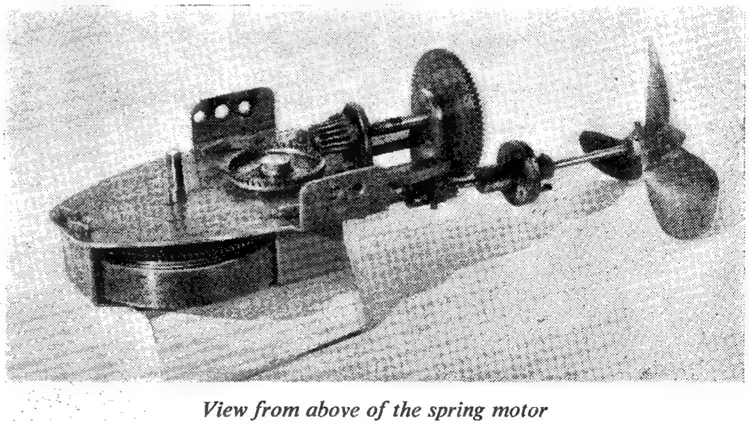
The ring-shaped life buoys are turned out of wood, 4 mm. thick, with handling guys of thin cord, and are lacquered white. The small life boat, seen on the photograph (length about 10 cm.), consists of brass tinplate, which is soldered together with tin strips on to a wood former.

The propeller has three blades and is made of brass. Its diameter measures 60 mm. The blades are soldered into the boss with silver-solder. If the blades are well fitted to the openings of the boss, soft-soldering, of course, will do. The shaft, gears and propeller are fixed with small adjustable screws on to their respective shafts.

In one respect this little model barge has given me more satisfaction than the model steamboat of double the size.

When we tried out the barge for the first time in the pond of a public garden where children play with their small sailing ships, I was overwhelmed with exclamations of joy from a whole gathering of small folk. Whole groups of children ran countless times round the pond, when the barge crossed the water.

My son kept the ship as an ornament in his room. So I was well rewarded by his pleasure for the work I had in constructing it.



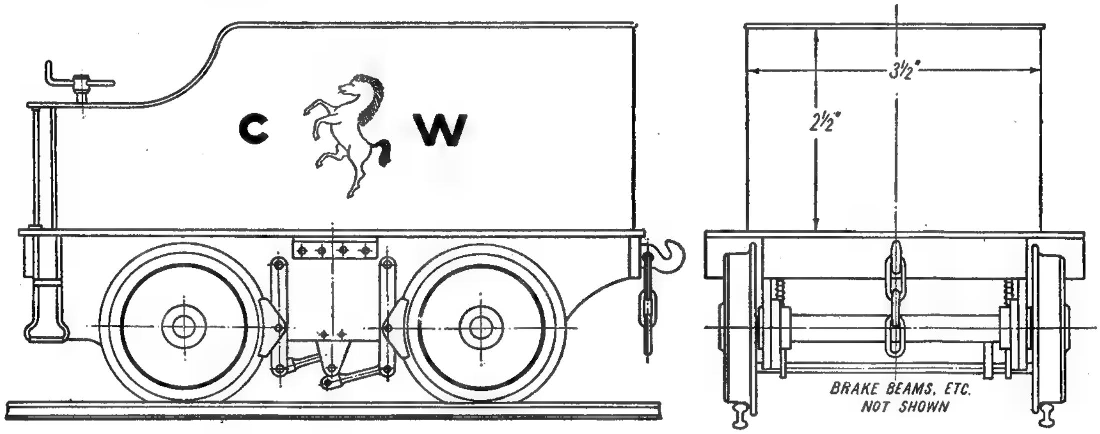
View from above of the spring motor

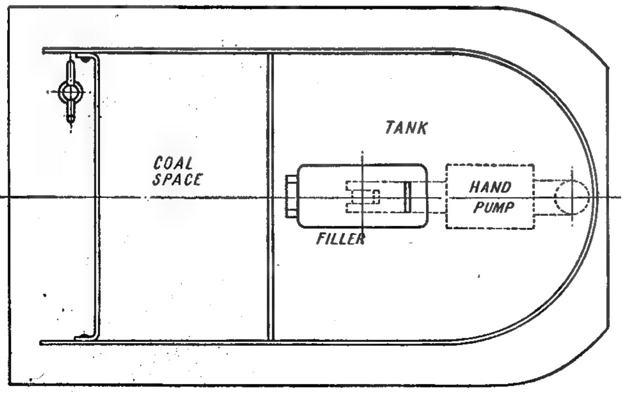
L.B.S.C.'s "Canterbury Lamb" in 3½ in. Gauge

CONSTRUCTING THE TENDER

THE next item on the menu is a drop of "mint sauce" to go with the *Canterbury Lamb*; in other words, the tender. Here, your humble servant was in a bit of a quandary, because no authentic drawing of the tender actually exists, to the best of my knowledge and belief. I have seen several old drawings, aquatints and suchlike, which purport to illustrate the complete outfit; but these are about as reliable as the illustrations of locomotives and trains drawn for novelette and other stories by non-technical artists who use their imagination, instead of obtaining a decent photograph of a locomotive or train, and taking their details from it. I once saw in an illustrated weekly, a picture of a railway station, with train and passengers, supposed to be in America. The passengers, especially the women, were exquisitely drawn, perfect in every detail; the architecture of the station wasn't so bad, either; but the locomotive—ye gods! It was a cross between a G.W.R. *King* and a French Chapelon compound, with hinges on *both* sides of the smokebox door, both side buffers and an automatic coupler, and a huge projecting pilot (or cowcatcher, as the kiddies call it) projecting so far out that neither buffers nor coupler could have been used. The outside cylinders drove on to the return crank; a weird and wonderful collection of rods supposed to be valve-gear, were coupled to the main crank, but didn't go anywhere near the cylinder! The high-ranking artist could have saved his technical reputation by obtaining a photograph, or picture, of an American passenger engine, and copying the details.

There was some excuse for the good folk who did their best to make drawings for illustrating the Canterbury and Whitstable Railway, for photography was unknown in those days, and locomotive engines were a new one altogether on them. In the *History of the Southern Railway*, and in *A Century of Locomotive Building*, there is a picture of the C. and W. "taken" from the hillside above Church Street, just south of Whitstable, showing the train on the opening day. The engine is shown as a





Side elevation, rear view and plan of the tender

single-driver, with wheels of unequal diameter, and the tender looks just like an old two-wheeled farm cart. The latter is certainly all wrong, for I have never come across any trace of a firm, let alone such folk as Robert Stephenson and Co., building two-wheeled tenders. The artist saw the train go by, and apparently drew on his imagination for details of the engine and tender, instead of going and taking a close view of her, and making a few sketches, at a

subsequent date, when she was standing still. *Invicta* was built a coupled engine, but the artist evidently overlooked the coupling-rods from his point of vantage on the hillside. Some years ago, I saw an old sketch—I forget for the moment who showed it to me—showing the old girl as originally built, with her *Rocket*-type firebox, and the " bell-bottomed " chimney. The tender was the same as first fitted to the *Rocket*, which was probably O.K., as *Invicta* followed the *Rocket* from the Stephenson works. It was a four-wheeled affair with what looked like a wagon body, surmounted by a glorified beer barrel to carry the water. Anyway, to cut a long story short, neither of the above tenders would do for our rejuvenated old lady; so I've drawn on my imagination, as I did when writing the little " peep into the future " with which I started this serial (hope you enjoyed it !) and have made a drawing of tender which will suit the modernised version of the ancient locomotive.

Ancient Yet Modern !

The tender is a four-wheeler with inside frames; if they were outside, it would make the whole bag of tricks look ridiculous, being so much wider than the engine. If our approved advertisers come up to scratch with some wheel castings with eight round spokes, or the kind that looks like a lace d'oyley, it will give the " period " look; otherwise, ordinary $2\frac{1}{2}$-in. gauge tender wheels can be worked in. It is partly for the latter reason that I have specified wheels only $\frac{5}{16}$ in. in width on tread, instead of my usual $\frac{3}{8}$ in. for $3\frac{1}{2}$-in. gauge. The other reason is, that the wider wheels would look rather clumsy on the weeny tender. The frames are of the usual pattern, with thickening strips at the sides of the horn slots; the springs are on top of the axleboxes, the pins working in lugs attached to the frames. I have shown the old-fashioned wagon brake gear, and am arranging for it to be worked by a brake handle and shaft of the usual pattern. Front and rear beams are made from angle; either steel or brass would do.

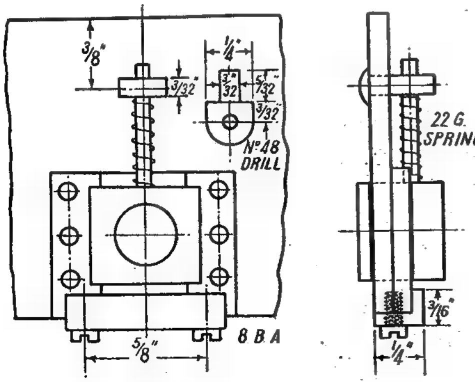
The old aquatint illustrating the view of the railway from Church Street, shows the " farm-cart " tender with a rounded rear end; so I have incorporated this feature in the body of the tender shown here. This can be seen in the plan view. To match this, the back beam is shorter than the drag beam, and the ends of the soleplate are curved in to meet the beam, and match the curve of the body. The early tenders had no front plates, and coal was shovelled off the floor, " spam-can " consumption being unknown in those days; but I have shown a front plate, otherwise the coal would either be spilled when running, or it would be knocked off when firing—probably both ! The coal space extends right down to the soleplate, so as to carry a fairly reasonable amount, and this doesn't leave much space for water; so in order to increase the water capacity, the tender will have a well bottom, reaching down to the axles, and extending almost the full length. The pipe connections for the eccentric-driven pump will be fitted to the front of this, thus saving some pipe work; and by turning the hand pump around, in the reverse direction to which these pumps are usually fitted, the coil can be arranged at the back of the well, and the feed pipe can pass underneath it. The filler hole is set forward, to be right over the pump lever, as usual. The whole issue is just a plain straightforward little job, and should match up nicely with the engine. I have shown the railway company's initials in plain block letters, on the tank sheet, and between them is the merry old White Horse of Kent, performing its usual antic—not to be wondered at, as *Invicta* was the first iron horse ever to be seen around Canterbury way, and the poor beast must have been scared absolutely stiff ! Well, let's get on with the job.

Frames and Beams

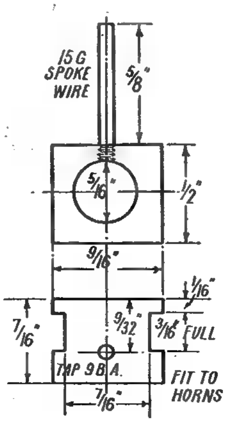
Two pieces of 3/32-in. steel plate, soft quality, either bright or blue, measuring 7 in. × $1\frac{9}{16}$ in. will be needed for the tender frames; these are cut to shape in the usual way, by marking out one only, temporarily riveting the two together, and sawing and filing to the given sizes. The two No. 40 holes in each top corner need only be drilled if it is proposed to screw the frames to the beams; the joints may be brazed or Sif-bronzed, as an alternative. The No. 40 hole above each horn slot is for the stem of the lug in which the spring pin works. The No. 30 holes farther along, are for the brake hanger pins. After cutting the horn slots, rivet a strip of 3/32-in. metal, $\frac{1}{4}$ in. wide and $\frac{3}{4}$ in. long, at each side of the opening, to form the horn cheeks. Use $\frac{1}{16}$-in. iron or brass rivets, set well away from the opening, so as to avoid fouling the axlebox flanges. Use a piece of $\frac{7}{16}$ in. square bar as a gauge, to prevent the horn cheeks overlapping the slots. Don't forget you need one frame l.h. and the other r.h.!

At the top of each frame, on the opposite side to the horn cheeks, rivet a 1 in. length of $\frac{1}{4}$ in. × $\frac{1}{16}$ in. angle, right in the middle of the length, as shown in the plan view. Directly under this, right at the bottom, and on the same side as the horn cheeks, rivet two little brackets, cut from 3/32-in. steel (odd bit of frame steel does fine) to the shape and dimensions shown. Before riveting the second one, carefully check measurements, with the frames placed together, so that the brake shaft will lie square across the frames when same are erected.

Both beams are cut from $\frac{1}{2}$ in. × $\frac{1}{8}$ in. angle, either steel or brass; the front one is $4\frac{1}{2}$ in. long, same as the engine drag beam, and the rear one is $3\frac{1}{8}$ in. long, the exact width over frames. The front one may be slotted, as described for *Tich*, the inner edges of the 3/32-in. slots being $2\frac{15}{16}$ in. apart; and $\frac{1}{2}$ in. of the top of the angle is cut away at each end. A $\frac{1}{8}$-in. slot, $\frac{3}{4}$ in. long, is cut in the

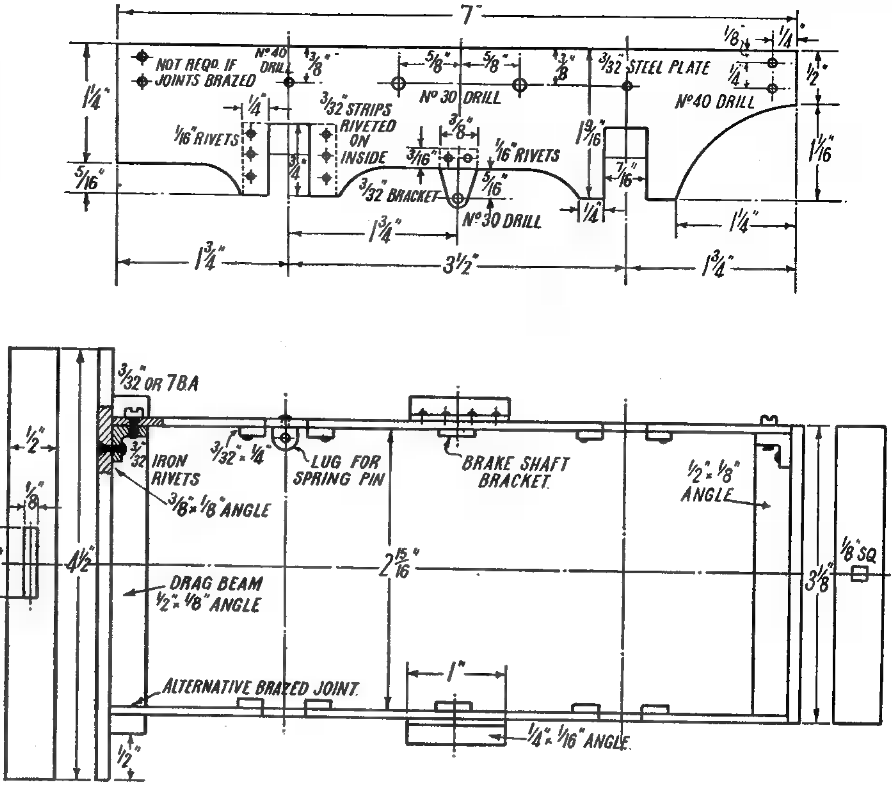


Axlebox assembly



Axlebox

face of the beam, for the drawbar. The back beam has 3/32 in. of the top cut away at each side, so that the frames lie in the recesses, and come flush with the edges of the beam. If angle fixing is desired, a $\frac{3}{8}$ in. length of $\frac{3}{8}$ in. $\times$ $\frac{1}{8}$ in. angle is riveted to the front beam as shown, level with the inner edges of the slots ; jam an odd bit of 3/32-in. steel in the slot, as a guide, and set the angle close to it. The angles on the back beam are riveted 3/32 in. from the edge. The frames can then be erected ; jam the front ends into the slots in the front beam, and set the rear ends against the ends of the angles on the back beam ; put a big cramp over the rear end, just clear of the screw-holes, to hold the frames tightly in place. Lay the assembly on something flat and level, on its back, and adjust so that the frames are in full length contact with the flat surface, also the beams; then run the No. 40 drill through the screw holes, making countersinks on the angle, follow with No. 48, drilling through, tap 3/32 in. or 7 B.A. and put steel screws in.



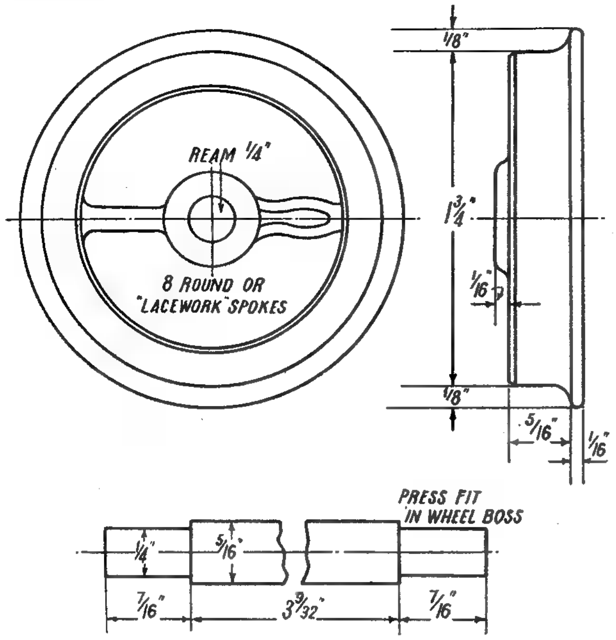
Tender frames and how to erect them

For a brazed-up frame, follow the instructions given for *Tich*; or you could assemble the frames on the flat surface, and then put a long $\frac{1}{8}$ in. wire stay through the drawbar holes in both beams. This should have enough thread at each end, to allow nuts to be put on inside and outside the beams; don't screw up too tightly, or the frames might be distorted, and take on a " permanent wave " under the heat of brazing. Coarse grade silver-solder may be used, though personally I should get busy with my " Alda " blowpipe, and pop a little dollop of Sifbronze in each corner. That's the stuff to give 'em !

Axleboxes and Springs

The axleboxes can be made from bronze or gunmetal bar, either drawn or cast. Our approved advertisers of castings should be able to do the needful; otherwise a piece of good quality drawn metal, of $\frac{7}{16}$ in. $\times$ $\frac{9}{16}$ in. section, about $2\frac{1}{2}$ in. long, will be needed. Tough yellow brass would also do; there is no driving stress to withstand, and precious little weight to carry. If cast stick is used, smooth off with a file; then clamp the piece of bar under the slide-rest tool-holder, at the correct height to allow a $\frac{3}{16}$-in. end mill or slot drill, held in the three-jaw, to cut out the grooves, to the dimensions shown. The grooved bar can then be chucked in the four-jaw, and the boxes parted off to length. Beginners should be mighty careful how they feed a parting tool into a rectangular bar; a little too quickly, and wham ! Away goes the thin end of the tool. One of my munition girls, in the Kaiser's war, was a dab-hand at breaking parting tools; the other girls called her " Parting-tool Carrie " I always saw that she had a few spares handy by her lathe, and taught her to set them up herself, which she did. The girls made up a chorus about her, singing it to the tune of the " Keel Row "; and, whenever there was a crack, followed by the Scottish air as rendered by the " Surrey Girls' Choir," everybody knew what had happened ! Carrie was a skilled machinist, and turned out beautiful work, which amply repaid for her only fault, trying to part off too quickly.

Axleboxes may also be sawn off the bar, to full length, then chucked separately in the four-jaw, and the ends truly faced. Each should then be fitted to a horn slot, easing the groove with a file, if necessary; they should slide easily without being too slack, although it isn't necessary to fit them as precisely as those on the engine. They should also be able to tilt a little, to prevent derailment on a road which has " cross-winding " in it. Mark each horn slot, and the corresponding axlebox, so that you can tell " t'other from which," as my old granny used to say. Mark off the centre of each box, centre-punch it, and drill a No. 30 hole through it. If you haven't a drilling machine and a little machine vice, the safest way of making sure that the hole goes through squarely, is to chuck the box in the four-jaw with the pop mark running truly (easy enough if you bring the tail-



Details of wheels and axles

stock centre up, as a guide) and then start the hole with a centre-drill in the tailstock chuck, finishing with an ordinary No. 30. Put the axle-boxes in place in the frame, and test for parallelism and squareness with a piece of $\frac{1}{8}$-in. silver steel. If O.K. open out the holes with 19/64 in. or letter "N" drill, then ream $\frac{5}{16}$ in., or finish with letter "O" drill. If any of the holes is out of truth, and the test wire doesn't lie square across the frames, correct with a file, re-drill a little larger, and carry on as described in the *Tich* instructions.

On the centre-line of the top of each axlebox, and 9/32 in. from the thinner flanged face, drill a No. 53 hole, tap it 9 B.A., and screw in a piece of 15-gauge spoke wire threaded to suit. You can buy 15-gauge plated cycle spokes at any cycle dealers' or repair shop, and they make bonny spring pins. The pins should project $\frac{5}{8}$ in. above the tops of the axleboxes. These pins slide in lugs riveted into the frames above the horn slots. To make the lugs, chuck a piece of 3/32 in. × $\frac{1}{4}$-in. steel in the four-jaw, setting it to run truly, and turn down 5/32 in. length to a full 3/32 in. diameter, a tight fit in the No. 40 hole directly over the centre-line of the horn slot. Part off at $\frac{1}{4}$ in. from shoulder, and ditto repeato until you have four of them. At 3/32 in. from the shoulder, on the centre-line, drill a No. 48 hole, and round off the end, to make it look pretty. Drive these through the holes in the frame, from the inside, and rivet over on the outside, as shown in the side view of the axlebox assembly.

To erect the boxes, wind up a piece of 22-gauge tinned steel wire around one of the 15-gauge cycle spokes, to form a spring, and cut off four lengths about $\frac{5}{8}$ in. long, touching the ends on a fast-running emery wheel, to square them off. Put one on each spring pin, and put the axleboxes in place, as shown in the assembly drawing. The horn-stays, which prevent the boxes falling out, are just $\frac{7}{8}$ in. length of $\frac{1}{4}$ in. × $\frac{1}{16}$-in. angle brass, one member of which is filed or milled away to $\frac{3}{16}$ in. depth. The angles can also be bent up from 16-gauge brass or soft steel sheet metal, in the bench vice; young Curly had to do that, in the days of long ago. Drill two No. 43 holes in the wider side, at $\frac{5}{8}$ in. centres, and attach the angles to the underside of each horn slot, as shown in side view of the assembly illustration, by two 8-B.A. screws. No objection to using any other size that might be handy, of course; but 8-B.A. screws are very neat. Finally, put the $\frac{5}{16}$-in. reamer through each pair of boxes, and move them up and down as you turn it with a tap-wrench; that is, if your reamer is long enough. Some aren't, but I have one that does it easily.

Wheels and Axles

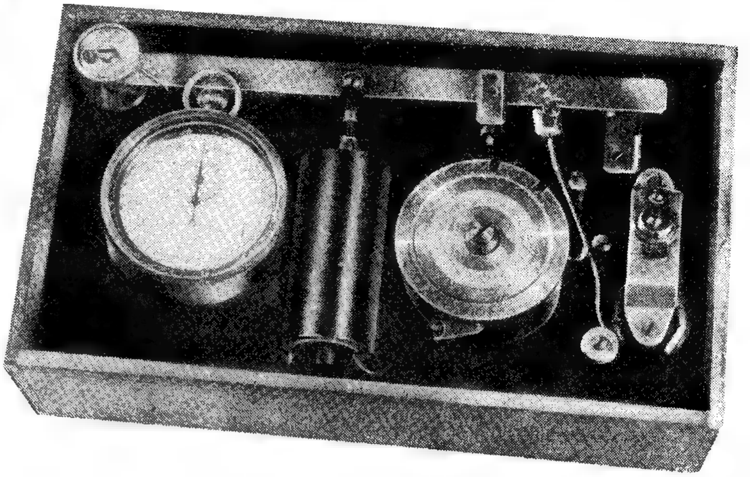
As these are machined up exactly the same as those on the engine, we needn't dilate on that job. The wheels are $1\frac{3}{4}$ in. diameter on tread, with $\frac{1}{8}$ in. rounded flanges; and don't forget that a rounded-off root to the flange, where it meets the tread, not only makes for easy running on curves, but minimises the wear on the rail heads. This is an important factor where sharply-curved brass or other soft alloy rails are used. The treads are parallel or cylindrical; no coning is required, the edge being bevelled off slightly as shown, I have already mentioned about the reduced tread width, and the shape and number of spokes.

The axles are turned up from $\frac{5}{16}$ in. round mild steel. If you can get the ground kind (both Reeves and Kennion have supplied me at different times) and the three-jaw is related to Mrs. Caesar, no turning of the centre part is required; but if the chuck is a descendant of Ananias, the best thing to do, is to use $\frac{3}{8}$-in. steel, and turn the axles between centres. Otherwise there will be more wobble on the wheels, than there would be on those of an ancient Model T "Tin Lizzie" which had skidded off the tramway lines and bumped into the kerbstones several times. I had one of these, during the Kaiser's war, and the gauge of the wheels fitted the tram-way lines exactly, so I often drove on the rails, to avoid the roughness of neglected stone and macadam paving.

However, returning to the job, here is a warning for beginners; don't make the wheel seats on the axles, too tight a press fit in the holes in the wheel bosses, otherwise the bosses will split. There is a happy medium in everything; and the seats should be eased near the ends, with a fine file, whilst the lathe is running fast. It only needs a weeny bit coming off, just so that the seats will enter the bosses a tight push fit for about one-third of the way on. After doing all the turning, press one wheel on each axle then temporarily block up the axleboxes in running position by putting a scrap of $\frac{1}{16}$-in. wire between the top of each axlebox and the top of the horn slot. The spring will hold it there. Poke an axle through each pair of axle-boxes, and press on the other wheel, using the bench vice as the squeezing medium; the wheels should then spin freely, and run perfectly true. Next items, bodywork and internal fitments.

An Electrical Timer

By L. R. Gawley



The finished timer. Stop-watch is enclosed in dural case

THIS timer is based on the original design of Mr. F. G. Buck and Mr. H. C. Wainwright, and was built by me from a photograph, which appeared in *Model Cars* some time ago.

The ratchet wheel consists of a 2-in. slitting saw, which is soft-soldered to a mild-steel boss, and rotates on a $\frac{5}{16}$-in. shaft mounted on the baseplate. The dural counter discs lift off for ease of changing, a separate disc being needed for each different length race, such as $\frac{1}{4}$, $\frac{1}{2}$ or 1 mile (6, 12 or 24 laps); a disc for 6 laps is in position in the photograph. The ratchet wheel assembly cannot be removed with the disc. The discs are located by a dowel pin on the ratchet wheel assembly.

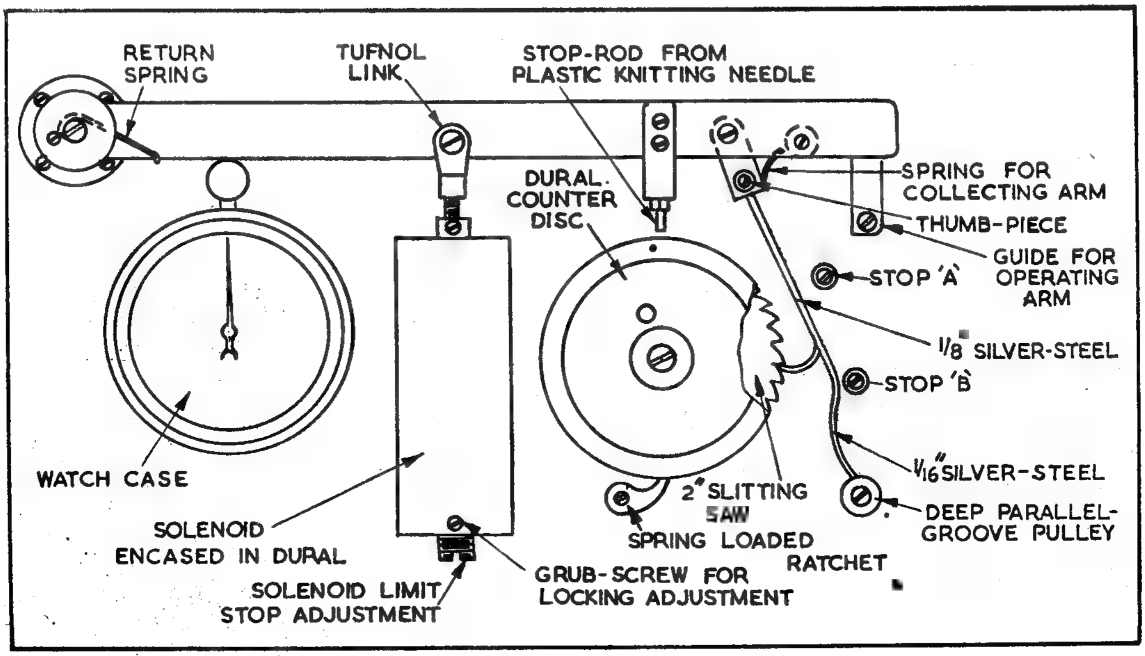
The operating arm is made from 3/32-in. × $\frac{1}{2}$-in. dural. It pivots at the end, and is fitted with a return spring, which is adjusted for tension by a knurled thumb-screw, and locked by a 4-B.A. centre bolt.

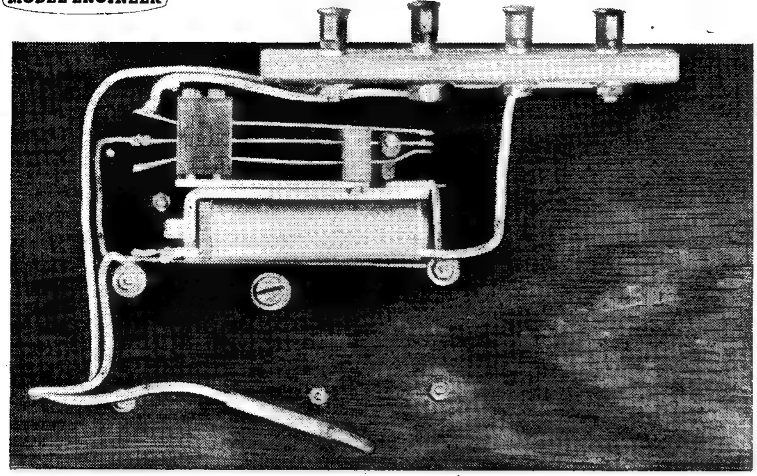
The stop rod is made from an old knitting needle (I think it is bone) so as not to burr up the edge of the counter disc; it is mounted in a dural block and screwed to the operating arm.

The collecting arm is made from $\frac{1}{8}$-in. silver-steel and hardened, and is pushed into the dural block and locked in position by the thumb-piece. The guide rod is made from $\frac{1}{16}$-in. silver-steel and soldered to the collecting arm; it is bent to shape and runs in a deep groove pulley to prevent the whole lot lifting or dropping when the arm is moved over for re-setting the timer.

The stop *A* is to prevent the ratchet wheel and disc overrunning when it has the extra pull at the beginning and end of the timed run (when the stop rod engages with the slots in counter disc). Stop *B* is to prevent the collecting arm being moved over too far and coming out of the pulley when it is moved over for re-setting. Both stops are drilled off-centre, so as to give a fine adjustment.

The solenoid was taken from an old





Underside view, showing relay and socket connections

car traffic indicator, and is enclosed in a dural housing; it is connected to the operating arm by a Tufnol clevis and swivelling link.

The timer operates as follows; the current is fed to the solenoid via a relay switch underneath the base-plate. It pulls down the operating arm, and the stop rod goes down in the first slot in the disc, starting the watch. The centre pylon breaks the circuit and the operating arm returns taking or gathering the counter drum one tooth; the pylon completes the circuit again and the arm is pulled down, but the edge of the disc prevents it pulling down and stopping the watch, and so on for the requisite number of laps. The last lap, of course, brings the second slot into line with the stop rod, letting the arm down far enough to stop the watch.

The four "plug and socket" connections seen in the photograph are two for the pylon and two for the battery; the current is led to the pylon, pylon to relay switch, then to solenoid, and it will work on a 6 V motor cycle battery with 50 ft. of twin flex from timer to centre pylon. The base is a piece of $\frac{5}{16}$-in. ebonite, and the complete timer measures 9 in. $\times$ 5 in. $\times$ $2\frac{1}{2}$ in.

To reset the timer, the operating arm is depressed, the collecting arm moved over to the right by the thumb-piece, and counter drum turned until the red dot on the edge of the disc lines up with the stop rod. Watch is set back to zero. The stop watch is enclosed in a dural case with a glass top, as can be seen in the heading photograph.

FOR THE BOOKSHELF

The Locomotives of the Great Western Railway, Part 2. (Published by the Railway Correspondence and Travel Society, Publications Officer, 18, Holland Avenue, Cheam, Sutton, Surrey.) 56 pages and 16 art-paper inserts. Price 10s. 6d.

This is a further section of the momentous, privately-produced history prepared by members of the R.C.T.S. It deals exclusively with the broad gauge engines owned by the G.W.R. from 1837 until 1892, and we doubt if anything approaching such detailed information about these engines has ever before been published. Many new facts have been unearthed by the enthusiastic authors and incorporated in what can only be described as a thoroughly comprehensive record.

The text gives descriptions, relevant dates and dimensions of every class of engine, together with many very interesting details of the broad gauge itself. Complete lists of names and, where applicable, numbers of the engines have been carefully compiled, not only in the text but also in an index which occupies the last eight pages.

The illustrations consist of, first, a fine frontispiece in full colours, showing engine No. 2002, formerly Bristol and Exeter No. 40, a stately 7 ft. 6 in. 4-2-2 express engine that was originally built as a 9 ft. 4-2-4 tank engine; secondly, a large number of halftone reproductions of photographs, some well known, others not so well known and a few unique; thirdly, numerous line-drawings of engines of which no other illustrations exist.

The whole style is uniform with previous parts published and is to be warmly commended.

4,000 Miles on the Footplate, by O. S. Nock. (Hampton Court: Ian Allan Ltd.) 223 pages, size $5\frac{1}{2}$ in. by $8\frac{1}{2}$ in. Illustrated. Price 17s. 6d.

This book is the third in which Mr. Nock has done so much—perhaps more than any other man—to present to a numerous, and often critical, public a carefully-recorded picture of the locomotive work done on the footplates of British locomotives. Once again, the text is interesting to a degree, highly informative and often quite exciting. To mention only three outstanding performances which, alone, are sufficient to justify this third book, we read vivid descriptions of: (1) a Southern "Schools" class engine, No. 30909, *St. Pauls*, making a superbly brilliant run from Cannon Street to Hastings with a 340-ton train; (2) a Western "Castle," No. 5029, *Nunney Castle*, arriving at Exeter in 9 min. less than scheduled time, with 390 tons behind her as far as Westbury, and (3) a run on Eastern Region "A4" class engine, No. 60029, *Woodcock*, working the 465-ton "Capitals Limited" from Kings Cross to Edinburgh, gaining as much as 38 minutes net on the scheduled time. Such runs as these arouse feelings of intense excitement, the more so because Mr. Nock has been careful to describe conditions prevailing on the footplates, and these conditions were sometimes not exactly ideal for really tip-top work.

At the other end of the scale, there are descriptions of runs on freight trains, local trains and suburban trains, in various parts of the country; and, although these are by no means so spectacular as the main-line express runs, they are often every bit as exciting and for the same reasons. No matter what type of train he is dealing with, Mr. Nock is always thoroughly informative and entertaining; as an engineer, he is fully alive to all the incidental details that apply to the handling of the engine concerned, and there is not much that his discerning eye and faultless judgment do not note.

The illustrations comprise 62 well-chosen photographs, depicting every type of locomotive and train referred to in the text.

THE "M.E." PROJECTOR

AN 8 MM. VERSION

By A. J. Cannon (Natal)

THE chain supplied by Messrs. Roox Products was of 8 mm. pitch and the sprockets had 12 teeth. These sizes brought the chain foul of the intermittent shaft, and it was suggested a jockey roller be used to overcome this. I was very dubious about this arrangement, so those sprockets were scrapped and two more made with 8 teeth. This allows the chain to take up a narrower space and it just clears all the other blobs and gadgets inside the gearbox. The bushes are all secured with thin nuts, as in the original "M.E." Projector.

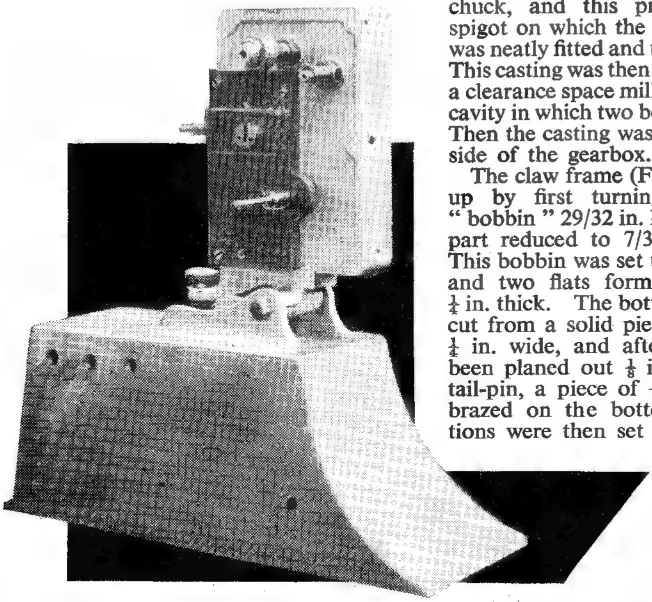
It became quite obvious when the first drawings were made that considerable changes would have to be made on the side of the gearbox, so the banjo housing (THE MODEL ENGINEER, March 24th, 1938) was eliminated, and in its place a flat gunmetal casting (*G*) fitted. At one sweep this fulfils all the functions of the banjo housing, and at the same time provides the necessary fixing space for the gear stub axles, the register to which the motion housing is rebated, and its fixing screws, the tail pin at the bottom end of the cam bridle, and the rocker arm which carries the lower sprocket film guide roller (Fig. 9). In addition it was necessary for me to move the centre-line of the lens and motion housing out ¼ in., because of large diameter of my projection lens. This made the centre-lines of the shutter spindle and the lens 1⅛ in. apart, and hence a slightly larger shutter was necessary. This gunmetal casting was first planed accurately all over, then mounted on the vertical-slide, and the $\frac{3}{16}$-in. hole for the intermittent spindle was drilled, bored with a tool held in the 4-jaw chuck, and finally reamed. Then the vertical-slide was loosened and turned through 90 deg. *without moving anything else.* This meant that the shutter spindle hole could now be bored and the centre-lines of the two shafts and their bevel gears would be exactly coincident. Also the wide surface of the vertical-slide gave an accurate means of measuring the 90 deg. angle. This spindle is 5/32 in. diameter, and the hole was bored with a tiny boring tool running eccentrically in the 4-jaw chuck The hole is 1¾ in. deep, so some patience was necessary, and it was finally reamed. Then the boss on the outside of this same hole was turned at the same setting with another eccentric tool held in the chuck, and this provided a true spigot on which the shutter housing was neatly fitted and thus centralised. This casting was then turned over and a clearance space milled in to make a cavity in which two bevel gears work. Then the casting was attached to the side of the gearbox.

Concluded from page 374, *March* 26, 1953.

The claw frame (Fig. 7) was made up by first turning a mild-steel "bobbin" 29/32 in. long with centre part reduced to 7/32 in. diameter. This bobbin was set up in the planer and two flats formed to make it ¼ in. thick. The bottom section was cut from a solid piece of mild-steel ¼ in. wide, and after the slot had been planed out ⅛ in. wide for the tail-pin, a piece of $\frac{1}{16}$-in. plate was brazed on the bottom. Both sections were then set up on a heavy piece of cast-iron plate planed flat on one side, and with a piece of thin sheet asbestos between. The ⅛-in. pins were set in loosely, and the whole assembly clamped lightly to the plate and the two pins brazed in at each end. At the same time the claws were brazed in. After cleaning up, the square cam bridle was attached finally, then the slotted foot was set up in the planer vice so the square bridle was true to the planer bed, and the two edges of the square foot skimmed up. This ensures that these faces run parallel to the line of action of the cam. The position of the foot-pin is very important, and this was found experimentally. It is only correct when it is so placed that the claw frame works *vertically* on the downward stroke and all the angularity occurs on the upward stroke. This is to prevent a see-saw action between the claws and film. Finally the top section was set up in the planer and the two 3/32-in. pins brazed in for claws were planed until they were the right size and the two working faces at a pitch of 0.150 measured with the micrometer collar on the cross-slide.

A dozen shutters were made before I was satisfied with the result, and I found that a piece of ordinary tin 0.012 in. thick was quite suitable for this component, provided care was taken not to buckle it in the cutting out process. It was balanced by attaching it to a piece of 5/32-in. silver steel and laying this on the vees of the lathe bed. In the end it was so well balanced that when the photographic black paint was applied the balance went out again ! Before assembly, all parts were scrubbed with hot soapy water and a nail brush, and then dried. This process did not, at any time, cause the slightest rusting difficulty, even on the steel shafts.

In the original articles 'Kinemette' stated that a 100-watt lamp was enough for this projector, provided it was designed to get as much light as possible through the picture. After many tests with lamps, even up to 300 watts, I must fully agree. The lamp finally adopted as a standard is a Philips Projector Lamp, No. 6056 N. This is actually a projector sound-track exciter lamp and is designed for 10 V 7.5 A. I use it at 12 V on load, so it is probably using about 100 watts and its life is amazingly good. It gives an intense white light and can be used a long time before any serious blackening results The area occupied by the filament is about the same size as one of the pictures on 8 mm. film, and this is very desirable



View showing gunmetal casting at side of gearbox

from the point of view of efficiency. However, when first set up, I had a spot of light on the back of the gate nearly as big as a florin, and it was obvious that the maximum light was not getting to the screen. No adjustment of the condenser lenses or lamp would correct this, so I began a wild search until eventually a simple magnifying lens was found, the same diameter as the condenser lenses, and it contracted the light beam till it just covered the aperture in the back of the gate. This lens was mounted in a ring and set up in front of the condenser lenses. The lamp was adjusted as described in the MODEL ENGINEER, June 2, 1949. The final results leave nothing to be desired on a screen 30 in. × 22 in., and even very much larger.

The machine was first tried out with the hand crank and the results were very satisfactory indeed. It was found essential to put a 20-in. blank trailer on the end of each film and to stop the machine as soon as the blank reached the gate. Otherwise if the film is run right off it will be found that when the end gets to the upper sprocket it curls round and locks, and the claws rip out a couple of perforations. This projector is very convenient to use where no mains are available. By simply leaving out the transformer, the lamp can be coupled direct to a 12-V car battery, and the hand crank supplies the power.

After the projector had been in use about a year, an alteration was made to the lower roller guides which hold the film on the sprocket. Fig. 9, shows the new arrangement, which in practice is a big improvement. A swinging arm works on a pivot-pin, which is screwed 0 B.A. in the casting (*G*-Fig. 5). This arm is held up to its job by a flat spring pushing on the part of the steady-pin, which projects through the back of the swinging arm. The roller rotates freely on the roller-pin. It is $\frac{3}{4}$ in. diameter by $\frac{1}{2}$ in. long, and shouldered down to go in between the two film guides on the film sprocket. Also it has a groove in its periphery, to clear the tops of the sprocket teeth. The polished brass steady-pin is not fitted with a roller, as the film pressure on this pin is so exceedingly light a roller would not turn even if fitted. All this pin does is to keep the film path from bulging. In practice, the swinging arm is pushed down, the film slipped between the steady-pin and roller, then over the sprocket and on to the take up reel. When the arm is released, the spring raises it and traps the film between the roller and the sprocket. The tension

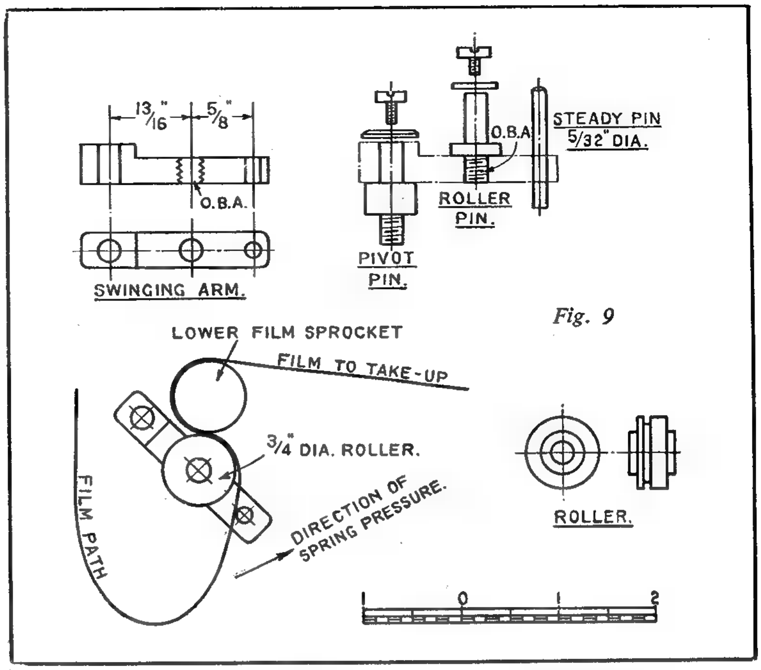


Fig. 9

from the take-up clutch holds the film down on top teeth of the sprocket.

Finally a start was made on the driving motor, and this proved the most exasperating job on the whole machine. I do not care for the usual series variable-speed motors used on projectors. The camera runs at 16 pictures per second, and the projector should do the same, otherwise there is something wrong with the film editing. The induction motor offers so many advantages, in that there should be no radio interference, no cummutator to look after, and it gives fairly constant speed Accordingly, induction motor stator and rotor laminations were ordered. I also asked for a winding specification and was told to put on 300 turns—or a little more. This must have been a frantic guess and is nowhere near correct. Some motor car scrap was used to cast the aluminium body, and end plates, and after these were machined, a start was made on the windings. The rotor is $1\frac{3}{8}$ in. diameter by $1\frac{1}{2}$ in. long with the usual squirrel-cage winding. The stator has two poles and a shading winding, so the motor may be expected to run just under 3,000 r.p.m. on 50 cycle mains. When it was found that the two coils of 300 turns each were hopelessly under-nourished, a series of tests was started using increasing numbers of turns. After four more pairs of coils had been wound I had reached 1,500 turns per coil of 38-s.w.g. With this the motor would run quite well, but only if it was first started by winding a string round the pulley. All the usual checks were applied, such as the centralising of the rotor, excessive friction, polarity, but all to no avail. Eventually in desperation a letter was sent to THE MODEL ENGINEER "Queries and Replies" service, giving full details of the difficulty. This reply put me in touch with Mr. Cooper, of Middlesex, and he really took a considerable interest in my troubles. His worked-out winding specification was 1,350 turns of 35-s.w.g. wire on each coil, and as this wire was unobtainable in this country he eventually sent me two coils ready wound. He also told me to plug the four ventilating holes, provided in the rotor, with soft iron rods tapped in to improve the magnetic path. This meant stripping and rebuilding the armature, but finally this was complete, and after overcoming a little difficulty with the belt being too close to one of the coils, eventually the day came when I switched on and the motor ran up to 2,800 r.p.m. The starting torque is still rather low, but the motor has ample power for the job, and even after running two hours is still quite cool to touch.

This brought to a close a most interesting job. Many details have had to be left out of this somewhat wordy description, but if any reader requires any further information I will be only too glad to send it.

READERS' LETTERS

● Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

GRADUATING A PROTRACTOR

DEAR SIR,—We must apologise to readers for an obvious error in the description given in a recent issue of graduating a protractor for the draughting machine, where the necessary reduction of 3 : 1 following the 60-T. wheel was omitted.

Where only two wheels are set up, the second change wheel clearly acts merely as an idler and does not itself affect the indexing.

In previous articles we have described correctly the method of graduating index collars by means of the lathe change wheels, and we hope, therefore, that interested readers detected the present error.

Yours faithfully,
"DUPLEX."

MULTI-GAUGE PORTABLE TRACK

DEAR SIR,—I don't really like "blowing my own trumpet," but I designed this track ; i.e. made the model for the society's approval (see THE MODEL ENGINEER for March 19th).

I, as one of the Friendly Motorists, journeyed many times to Stafford on a motor-cycle in bad weather—and it's no small distance. 'Twas I who cut and carted all sleepers, again on a motor-cycle, to Stoke-on-Trent. 'Twas I who made the ball-bearing driving truck, and I'm sure I'm voicing the opinion of all our members in asking you to print this picture of myself driving the first train of budding model engineers as passengers—all sons of members.

The G.W.R. saddle-tank job is also of my own making, and I hope to send a "yarn" about it when I've made a better chimney.

Yours faithfully,
Cheadle. JOHN M. BALL.

MODEL TRACTORS

DEAR SIR,—I was most interested to see the picture of a model "Fordson" standard agricultural tractor on the cover of a recent issue of THE MODEL ENGINEER.

Your note on the picture does not, I fear, give a very accurate outline of the question of information, because the motor tractor is a present-day machine, and plenty of sales literature and instruction manuals are available to those who care to approach manufacturers or agents. Fords are especially helpful, and I have manuals of both the "Fordson" tractors, also a scale outline drawing of the "Fordson Major" tractor,

With regard to the difficulty of building a working model, I think a steam tractor is a far more formidable job ; after all, the work involved in building a petrol tractor is mainly turning, as there is no boiler work and riveting ; agreed that it would be a *long* job.

Bearing in mind the information available, would it not be a good idea for the "M.E." to consider the preparation and publishing of a series of articles giving a design for a working model of the most popular of tractors—the "Fordson Major," using, of course, the "Seal" engine, with sets of dimensions for 15 and 30 c.c. editions ? If I could assist in any small way, I should be very pleased to do so.

Yours faithfully,
Bickley. G. O. CAIRD.

HEATING RESISTANCES

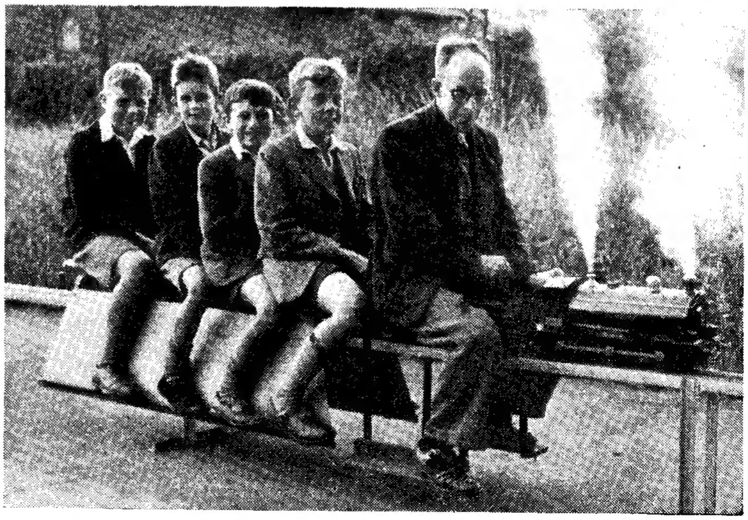
DEAR SIR,—If, as Mr. May states, he has had trouble with a wire element lead failing, he must have been running the element above its proper rating. About 20 years ago I was for a time engaged in the making of various experimenta electrically-heated muffles in one of this country's largest research laboratories. To get the heat required, we used, on occasion, platinum wire run as near melting point as possible. They always failed under these conditions, and never in the same place twice ; they stood up anything from a few hours to a fortnight. Any form of joint in any kind of heater caused trouble sooner or later.

M.E.P. (Marlborough) who asks a question about an electric muffle furnace may like to know that we always used Purimachos fire cement direct on the element.

We then soaked, or rather wetted, a piece of asbestos millboard of suitable size, wrapped it round it, wound ordinary cotton tape over this, and allowed the asbestos to dry out, when the tape was removed. The whole was mounted in a metal box, and slag wool or similar material used to fill up.

M.E.P.'s idea of winding directly on to muffle or crucible pot is quite sound therefore, as there are literally dozens of similar furnaces in use today in the laboratories mentioned ; they take a long time to heat up, though.

Yours faithfully,
Stockton-on-Tees. R. E. BARKER.



Holding small discs in the chuck

By "Duplex"

REDUCING the thickness of a thin collar or a washer by gripping it in the chuck and then taking a light facing cut can be a tiresome job. Setting the work to run without wobble in the chuck jaws by a process of trial and error often wastes much time, and is hardly feasible for machining a batch of parts. Better results, when gripping a single part, will be obtained if the test indicator is used to find the high spot, so that this can be tapped lightly inwards. Before going further, it should, perhaps, be emphasised that the self-centring chuck should never be heavily tightened where the work is gripped only by the tips of the jaws, for any injudicious treatment of this kind can easily strain the jaw slides and render the chuck useless for accurate or even secure holding. If the work is supported, as it should be, against a distance-piece, the chuck jaws need do little more than afford a driving hold. Various methods are used in the workshop for setting thin pieces of work to run free from wobble. A distance-piece will provide an abutment face, but a separate fitting of this kind may have to be made to suit work of different diameters; moreover, the distance-piece is liable to rattle in the chuck jaws as the mandrel rotates. Another way is to align the work against the jaw faces of the tailstock drill chuck or against the end of a rod gripped in the chuck; or, again, a tailstock drilling-pad can be used for this purpose; but some difficulty may be found in setting small parts in this way.

A Special Fixture

The need of something rather better than these methods could offer was felt recently when a batch of thin collars had to be reduced slightly in thickness and the two surfaces kept exactly parallel. For this purpose, a special fitting was made up and, for this to be worth while, a single fitting was designed to align work of from $\frac{1}{2}$ in. dia. up to nearly the full holding capacity of the self-centring chuck.

The finished appliance is illustrated in Fig. 1 and the separate parts are shown in Fig. 2. Three scrap-ends of mild-steel are enough for the construction, and the method of using the fitting is illustrated in Fig. 3. The body part (A) fits inside the chuck body clear of the jaws, and the threaded spindle (B) reaches as far as the jaw faces. The spindle is now turned with a screwdriver until the abutment face is set back far enough for the chuck jaws to grip the work, but leaving the part projecting sufficiently for the machining operation.

In this way, the work is fully supported, and a batch of parts can be quickly machined with parallel faces;

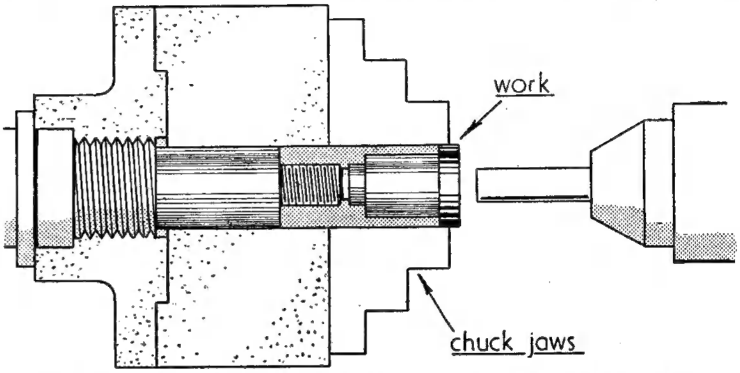


Fig. 3. The fitting in use for aligning a work-piece in the chuck

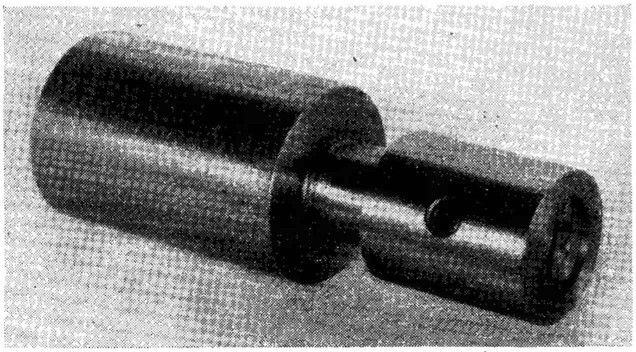
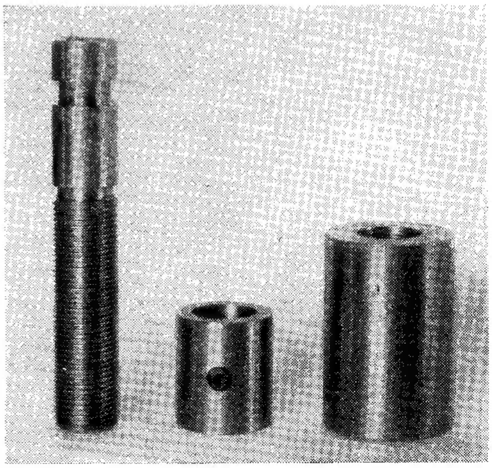


Fig. 1. The finished chuck fitting

Right—Fig. 2. Left—the spindle; Centre—the adapter; Right—the body of the appliance



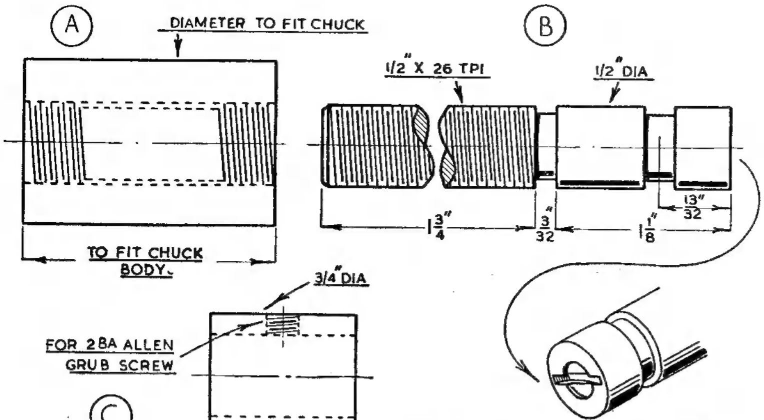


Fig. 4. *"A"—the body; "B"—the spindle with inset view of the slotted end; "C"—the adapter*

moreover, a uniform thickness can be maintained if the lathe saddle is kept locked. For larger work, adapters of any required size can be mounted on the spindle, but the $\frac{3}{4}$ in. dia. adapter illustrated will serve for aligning work of much larger diameter.

To avoid errors in mounting, the work can be firmly pressed against the end of the spindle, while the chuck jaws are being tightened, by using either a pressure pad or a length of faced rod held in the tailstock drill chuck.

Construction

The body (*A*) it turned from mild-steel bar to a light push fit in the chuck body, and when it is in place the chuck jaws are left free to close on the spindle (*B*).

The part is next drilled axially and the bore is finished to a diameter of 29/64 in. with a boring tool, for it is essential that the bore should be central and in true axial alignment.

A $\frac{1}{2}$ in. × 26 t.p.i. tap is now put in by locking the lathe mandrel and turning the tap, while supported by the back centre, with a tap wrench. As the tap goes forward, it must be closely followed up with the back centre in order to maintain alignment.

After the tap has entered for $\frac{1}{2}$ in. or so and has obtained a good hold, the part can be transferred to the bench vice and the tap put right through the work.

The body need not necessarily be tapped 26 t.p.i.; any other pitch will serve, as long as free-working and shakeless engagement of the parts is obtained.

The Spindle (B)

A length of $\frac{1}{2}$ in. dia. mild-steel rod is threaded to screw into the body. The thread must be accurately cut to avoid any wobble of the spindle as it turns in the body part, and it is, therefore, advisable either to use a die fitted with a guide collet or to screwcut the thread in the lathe. If a die is used, it should be adjusted to cut a thread that fits closely in the tapped hole. Before mating the two threaded parts, they should be cleared of chips by swilling them in a jar of paraffin.

When screwed fully home in the body, the outer end of the spindle should lie some $\frac{3}{8}$ in. short of the ends of the chuck jaws and, to enable this distance to be adjusted when gripping the work-piece, a screwdriver slot is cut in the end of the spindle, as illustrated in Fig. 4. This slot is milled in the lathe with a small circular cutter mounted on an arbor between the lathe centres, and the spindle is held at centre height in the toolpost. After cutting the slot, the end of the spindle is again faced to form the working abutment face, and the centre is also relieved to prevent any burrs set up by the screwdriver affecting the abutment face. Finally, a groove, $\frac{1}{16}$ in. deep, is cut with a parting tool to form a seating for the 2-B.A. grub-screw securing the adapter in place.

The Adapter (C)

This was turned from $\frac{3}{4}$ in. dia. mild-steel rod to provide an abutment face for work of large diameter. The bore is machined with a boring tool to a firm sliding fit on the spindle, and both ends are faced flat. In Fig. 4 the adapter is shown drilled at the middle of its length for the grub-screw; the adapter then projects for some 1/32 in. beyond the end of the spindle. But greater projection of the adapter is obtained by fitting the grub-screw towards one end; this will enable the bore of a washer to be drilled out without danger of damaging the end of the spindle.

This finishes the construction and, on trying the appliance in place, it should be found that, after pushing the body into the chuck, the spindle can be readily set with a screwdriver to give the chuck jaws the required length of grip on the work.

KNOW THAT WOOD SCREW

How often have you wondered what size wood screw you are using?

What do you ask for when you want to purchase more?

Then when you have them, and are going to use them, what is the core size, and what is the clearance size. The last is easy, but what about the other two sizes?

Correct core size is essential for a good-fitting screw. First, to determine the size of the screw, measure the diameter of the head in sixteenths (or state size you wish head to be). Multiply this by two, and then subtract two; this number is the wood screw size.

Example

Diameter of head ..	.. $\frac{5}{16}$ in.
Multiply 5 by 2 ..	.. 10
Subtract 2 ..	 8
Size of wood screw	*Number* 8

Then from the table shown below you can get core and clearance sizes :—

Example

Number 8 wood screw
Core size—7/64 in.
Clearance size—11/64 in.

—J. Pitchford.

SIZE OF WOOD SCREW	0	2	4	6	8	10	12	14
CLEARANCE SIZE DRILL	1/16"	5/64"	7/64"	9/64"	11/64"	13/64	15/64"	17/64
CORE SIZE DRILL	NO.55	NO.54	5/64"	3/32"	7/64"	1/8"	9/64"	5/32"

QUERIES AND REPLIES

" THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with :

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked " Query " and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Corliss Valve Gear

I wish to obtain particulars of Corliss type valve gear, and shall be obliged if you can refer me to any drawings or information on this subject.

J.H.G. (Salisbury).

The drawing reproduced herewith shows the Corliss valve gear in its original form, as applied to a vertical-cylinder beam engine. Both the drawing and the description are taken from D. K. Clark's text book on the steam engine, and the description, quoted verbatim, is as follows:

" The valve-gear first employed by Corliss is shown in the figure. A weight *H*, attached to a lever on the valve spindle *L*, supplied the external force for closing the valve, when the catch *K* was liberated, the weight falling in a dashpot like that on Watt's gear. The tripping of the catch was effected by curving up the back end at *K*, which came in contact with a plate *L*, acted on by an inclined plane or wedge on the rod *M* connected with the governor. The plate *L* is raised or lowered according to the changes in the position of the governor balls. When it is lowered by excess of speed, the catch *K* is tripped sooner, steam is cut off earlier and the supply reduced. The first steam engine fitted with Corliss gear was a beam engine, in which flat slide-valves were used. The cylinder with the valve-gear is shown in the figure, without the application of the governor. The cut-off was adjustable during the working of the engine. The valves were moved by small rollers *F F*, by means of toothed segments. The levers *L* on the shafts of these rollers were formed with catches, which took into notches on the motion-rods *E E*, the other ends of which were pinned to and moved by an oscillating disc *A*, which derived its motion from an eccentric and its rod *B*, and which imparted the required reciprocating movement to the steam-valves, and also the exhaust-valves *F*1, *F*2; with this difference, that the exhaust-valves were constantly in gear and in motion as ordinary slides, whilst the steam-valves were subjected to the action of the trip-gear. The motion-rods *EE* were pressed against the ends of the levers *LL* by the springs *SS*, and they were disengaged in coming into contact with the bolts *RR*. The degree of projection of these bolts, and the consequent variation of the cut-off, were effected by adjustment of the bar *N*, vertically, being formed with inclined planes *MM* which acted on the bolts. The higher the bar *N*, the more the bolts approached the motion-rods, and the sooner these were pressed back and disengaged."

Plans and Materials

Before starting on something to model, I would like to know what plans are available, and also where I can obtain materials.

A.B. (London).

Our publishing department issue a plans list on numerous subjects, and materials and castings are advertised regularly in our pages.